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Forthcoming Events.

SEPTEMBER 5-22.
Machine Tool and Engineering Exhibition at Olympia, London.

SEPTEMBER 24-OCTOBER 6.
World Power Conference:—Fuel conference at Imperial Institute, London.

An Unconscious Disservice.

It has come to our notice that a prominent firm of pig-iron manufacturers in the Midlands has circularised at least a portion of the foundry industry with a reprint from a daily paper containing an account of a visit paid to them by a section of the Institution of British Foundrymen. While this constitutes an excellent souvenir of the occasion, it has reacted in a way which we feel sure was not envisaged by those responsible for its despatch. The general manager of the concern is reported in this reprint to have said: "At the works they had a foundry of their own, and so, fortunately, they were able to judge fairly accurately what their respective irons would do. He (the speaker) would like to pay a very great tribute to their foundry foreman. It was true that the foundry at the works was only small, and that they did not work to the pressure of a commercial undertaking, *but in the past three years they had had only one waste casting*, and that was rather in the moulding than through any fault in the iron." The italics are ours, because it is this statement which has created some consternation amongst foundry owners. Now, in order to be perfectly clear as to what wasters can mean, we would quote Dr. Moldenke, who stated that the largest automobile foundry in the world regularly made a 25 per cent. defective casting loss on the foundry floor. Our information shows very clearly that this reprint has been received by several foundry owners who have not had any practical training, and have sent for their managers and foremen for an explanation as to why they return a 5, 10 or 15 per cent. waster record each month. Whilst we do not deny that a small foundry may have succeeded in producing only one waster casting in three years, we do categorically assert that it is an extremely rare case and not one which can be reproduced in other shops. Moreover, it is such a phenomenal affair that it warrants a much fuller explanation as to the type of casting made, quantity of metal melted, etc., or completely ignoring. As it stands, in the form of a bald statement it is liable to engender misunderstanding between the directorate and management. We hasten to assure those owning foundries, yet not conversant with its practical conduct, that one waster casting in three years is definitely phenomenal and can be dismissed from the mind, as the percentage of defective castings varies according to simplicity or complexity of contour; to the specification imposed; to wide variation in the nature of the output; to variations in the raw material used, and to a hundred-and-one things, some of which are at present beyond human control. Classical cases exist where mice and rats have bored their way into moulds and caused unexpected wasters. From this incomplete survey, it is evident that any serious consideration of attaining one waster casting in three years can be ruled out in 99 cases out of 100 as being beyond the sphere of practical politics.

Employers and the Schools.

Following the Ministry of Labour report on apprenticeship, referred to in a recent issue, two further reports on Education and Industry have now come from Committees of the Board of Education. One Committee sat for England (the so-called Malcolm Committee) and one for Scotland.

It is impossible to read these reports without reflecting upon the comparatively unfavourable showing made by the organised employers. Many official bodies in the country having a vested interest in education presented their views, and organised labour clearly favours an extension of the school-leaving age. The employers, however, presented a memorandum emphasing their views on two matters, both unfortunately negative in character. They are opposed equally to an extension of the school-leaving age and to the establishment of part-time continuation schools on the lines of the Fisher Act of 1918. This Act was never put on the Statute Book, and it provided that boys between 14 and 18 should have several hours per week, during working hours, in school.

Since, as the report hints, one or other of these alternatives is likely to be adopted during the next few years, it seems particularly unfortunate that the organised employers have made no attempt to discriminate between the two and to assess their respective advantages or demerits.

The report has been quick to seize on the negative attitude of the employers, and says, with some truth, that the memorandum they submitted "removes any suspicion that the employers of this country had already formulated a body of definite views and requirements which were being ignored by those responsible for education," and goes on to show that it virtually discounts criticism of the present educational system.

Is it not possible that a highly centralised body can get out of touch with the views of its constituents? There are hundreds of manufacturers' associations, and it seems not unlikely that in the Confederation responsible for these views, the ideas of too few people may have too markedly predominated. At any rate, it is remarkable that the views of many well known and progressive employers, keenly interested in and concerned with education, should not have coloured these statements to any extent. Even if they could have pulled no weight they would have shown the diplomatic undesirability of an attitude entirely negative, and presenting no likelihood of a change of front. This, we venture to think, is the attitude of the less progressive employer which has in a measure created the problem with which British industry is now confronted. It is fatal to give the teaching profession, education authorities and others, the chance of complacently thinking that industry betrays in regard to education nothing more than stubborn opposition, based on an unyielding negation, to educational changes, when it should have a considered and carefully thought-out policy. Labour policy is much more clearly defined.

Employers are the largest contributors to education rates and a negative attitude deprives them of a valuable opportunity. If the system is right they must accept it and use it. If it is wrong they must reform it. As the report quotes, "Industries must define their needs and no other body can do it for them," or, as the Balfour Committee on Industry and Trade says, "What is needed is that each great industry should make its educational needs the subject of thorough and systematic examination, for until this is done the indispensable conditions are wanting for the right solution of the outstanding problems."

XUM

Rapid Costing for Small Foundries.*

By Sñr. Jaime Coll y Soriano (Lt.-Col. Engineers), Am.F.Ass., M.I. and S. Inst., M.Inst.B.F., A.T.F. Member of Permanent Committee for Testing Materials.

Colonel Coll pointed that so much had been written on this subject both in Europe and America that he would not have ventured to discuss it were he not impressed with the necessity of an active propaganda for the purpose of getting rid of the confusion prevalent in prices and quotations on the market for cast iron in all industrial countries.

At a meeting of the Cast Iron Cost Price Committee of the American Foundrymen's Association at Syracuse, N.Y., in 1925, Mr. Runge said that more than 90 per cent. of the foundries known to him obtained their average cost prices, forming the basis of their offers, by dividing their total annual expenditure of every kind by the tonnage of the product to be sold.

The German Foundry Owners' Federation in 1924 recommended its members to draw up their estimates in accordance with detailed rules and provisions, or at least by means of an approximately synthetic formula more suitable to the requirements of the market than the unsuitable average price mentioned by Mr. Runge. The Foundry Trade Journal periodically publishes articles criticising the confusion prevalent in the determination of prices for tenders, and the Belgian and French Foundry Associations had long recognised the full importance of the problem by establishing their Cost Price Committees. Everything, said Col. Coll, went to prove that the confusion was universal.

While the larger undertakings had foundry accountancy systems enabling them to determine their costs fairly exactly, these systems, which had frequently been the subject of reports and discussions at Foundry Congresses, irreproachable as they might be, *were not practical*, and could not be adapted to small foundries with a production of less than 500 tons per annum. It would be difficult to persuade these small founders that it is much less costly to pay a works accountant and assistant than to sell a portion of the output below cost without being aware of it.

In foundry work, as everywhere else, it happened that there was no "enemy" insignificant enough to be neglected. In the open market the small founders who did not calculate (the 90 per cent. mentioned by Mr. Runge) were veritable enemies, not merely of their competing colleagues, but of the trade as a whole, for they depressed prices, and yesterday's suicides furnished no lesson either for the unfortunates of to-day or the lunatics of to-morrow.

He had been led to believe, therefore, that since a perfect system of costing—many of which could easily be cited in Europe and America—was not accessible to these 90 per cent. who had to be considered, it was preferable to lay down the foundation work of a sound system of guidance by drawing up simple rules, naturally only roughly accurate, but enabling estimates of a less fantastic nature and less liable to result in self-deception to be drawn up, without any exceptional cost as regards staff.

It was for this purpose that Señor Cañameras submitted his report to the Paris Congress in 1927, and it was regrettable that instead of endeavouring to fill up the gaps with the calculation of the cost of liquid metal and the proportion of indirect and overhead charges, the Meeting got out of the difficulty by recommending two systems as perfect as they were impractical (at least for the 90 per cent. in question), viz., those of MM. Feron and Rocheport, which even take into account the quantity of sand required for each mould—a most interesting detail, if only there were time to consider it in a small foundry.

In his opinion this was not a means of correcting the existing errors. It was much more practical to approach the goal by successive stages. His suggestions were in no sense merely theoretical, for they were the result of his personal experience in a foundry which ten years ago was comprised in Mr. Runge's 90 per cent. At this foundry a rudimentary system of shop accountancy was established *without any additional staff*. He had himself drawn up *résumés* and comparative figures, and they had arrived at a formula which, when applied to castings already made, gave approximately the cost, which was already known, as a mixed ratio of the weight of material and the direct labour. When a fresh case occurred it was sufficient to know the weight, and for the foreman to estimate as closely as possible the cost of moulding and coring, in order to be able to draw up estimates approximating with certainty to the cost price, which could be first checked on the execution of the order and later when the annual accounts were made up.

Of all Spanish foundry owners, Colonel Jaime Coll y Soriano, the author of this Paper, is probably the best known on account of his membership of the various national foundry associations. He is obviously well-informed as to the progress of costing made in all countries, and the system he has evolved is the essence of simplicity and is applicable to the smallest concerns.

The Paper can be regarded as a protest against the complicated systems essential for large organisations, but which are overwhelming for the smaller foundries.

Cost of Metal at the Spout.

These preliminaries were necessary in order to avoid useless discussion as to the accuracy of his calculations. It was a question of approximativeness. He proposed first of all to determine the cost, per 100 kg. of iron charged, of the raw material and the melting. He gave (see Table I) an example of cost calculation (raw materials and melting) per 100 kg. of iron charged in a cupola 0.78 metres in dia. at tuyere level for a melt of 10,000 kg., using 10 per cent. of Priestman coke between the charges and taking the percentage of bed coke on the tonnage of the entire charge. It was assumed that the overhead charges of the works were 80 per cent. of the value of the direct and indirect labour.

If several kinds of pig, ferro-alloys or deoxidising packets were used in the ladles or additions of various kinds in the cupola; if the costs in the annexed table were more or less high, and if a percentage of cost per ton for laboratory work had still to be added, together with that for the entire renewal of the refractory lining of the cupola and other minor expenses included in the 2 per cent. contingent expenses, it would be easy to rectify the figures in the table and adapt them to each particular case. This calculation was merely a first approximation—a guide for those who had never before studied the matter. It should be added that the resulting price might vary considerably more or less if the aggregate charges were greater or less than the 10,000 kg. (10 tons) presumed. There were certain important factors, such as the initial charge coke, the lighting wood, preparing the bottom, and the tap hole and ladle, which were fixed irrespective of the weight of the charge; other costs, such as that of the refractories, labour in lining and foundry tools, were not precisely proportionate to melting time. For example, if in the same cupola the total operation were one of 6,000 kg. instead of 10,000 kg., the cost per 100 kg. charged would have been 25.40 ptas. instead of 24.70 ptas. as in Table I.

To avoid regrettable errors in determining cost, the special features of each works must be considered and the calculation must be made three times: for the maximum, minimum and average operation, without aiming at accuracy in the average, but at the most frequent tonnage. With these three results a table would be compiled, and its average figures applied whenever costs were required for estimates and quotations.

The table comprises nine columns bearing the following captions: "Weight of each casting" (scaled up in 10 steps to a kilo to 2 tons); "Useful weight required" (this is standardised at 100 kilos—about 2 cwt.); "Unusable" (standardised 8 kilos or 8 per cent.); "Runners," etc. (here for 100 kilos of castings weighing 1 kilo each, 200 kilos are allowed, whilst at the other end of the scale, that is for 2-ton casting, here for each 100 kilos weight only 8 kilos are allowed for runners and risers, etc.); "Total" (this figure is the sum of weights in cols. 2, 3 and 4, and in the case of 100 kilos of 1 kilo castings it amounts to 100+8+200=308 kilos. In the case of a 2-ton casting it is only 116 kilos; "Melting Losses, 7 per cent." In the case when making 100 kilos of castings weighing 1 kilo each, a simple calculation shows that 21.56 kilos have to be added. Column 7 has three captions: "Weight to be melted"; "Cost per 100 kilos at the spout"; and "Cost of Metal." Thus for 100 kilos of usable castings weighing 1 kilo each, the weight to be melted is 308 + 21.56 (melting loss)

Table I.—*Cost of Raw Materials and Melting.*

For the complete melt of 10,000 kg.	Per 100 kg. charged.	Pesetas.	Per kg.	Pesetas.
Pig		—	40 kg. at 220 Ptas. per ton.	8.80
Scrap		—	60 kg. at 200 Ptas. per ton.	12.00
Coke		—	14 kg. at 90 Ptas. per ton	1.25
			20 per cent. charge coke	
Limestone (flux)		—	2 kg. at 16 Ptas. per ton	0.032
Lighting wood, etc.	200 kg. at 50 Ptas. per ton	10.00		0.10
Refractories		50.00		0.50
Motive force for fan	5 hrs. at 8 kw. at 0.25	10.00		0.10
Supplies for motor and fan		2.50		0.025
Tapping rods		7.00		0.07
Labour for lining, patching and preparing cupola		18.00		0.18
Handling raw materials, including weighing and crushing		35.00		0.35
Labour: Chargers, skimmers and tappers		20.00		0.20
Overhead charges: 80% on the three preceding items		—		0.584
				24.00
			2 per cent. contingent expenses	0.484
				24.685

Or in round figures 24.70.

A Peseta equals 6.076 pence; or 29.5 equal £1. A Kilogram equals 2.2 lbs.

* A Paper presented to the recent Spanish Foundry Congress.

= 329.56 at 24.70 ptas. = 81.40. At the other end of the scale this works out 30.66 ptas. Column 8 bears the caption "To be deducted for Reclaimed Metal." This is the sum of columns 3 and 4 multiplied out at 20 ptas. per 100 kilos, and in the case of castings weighing 1 kilo each is 208 at 20 = 41.6 ptas. The last column is "Costs of the metal per 100 kilos of saleable castings in ptas. It is, of course, a plain subtraction of the figures in column 8 from column 7, and in the case of castings weighing 1 kilo is 39.8. For 2-ton castings the final figure is 27.46.

Cost of Castings.

The figure of 24.60 ptas. calculated represented only the melting cost per 100 kg. of iron charged in the cupola. What was required was the cost of the metal in the form of saleable castings. The loss in weight must be taken into account to fix approximately the cost of the molten iron and the cost of the melting required to obtain it. It should be noted that the loss began at the spout; the metal already showed a loss from oxidation and slag reactions which may return to the cupola—a loss which might vary from one-seventh to double the weight of the castings. Apart from the greater or less risks of spoiled castings to be remelted, which everyone could allow for in his estimate according to his personal experience, and the surplus or excess metal after melting, the highest figure of weight for remelting was furnished by the deadheads, cuttings, risers and runners.

The most exact method would be to determine *a priori*, by calculation based on plans, the probable weight of the cuttings, risers and runners for each casting, but that would mean returning to estimates of the old and the new sand for each mould. In the shops of which he was speaking there was no staff with the time to make these minute calculations.

The German Foundry Owners' Federation had no doubt appreciated this difficulty, as it had compiled its tables which everyone could modify at will if he considered that the percentage of loss and spoiled castings was different from the figure indicated. If there was any doubt, it was better, before instituting a check over a period of one or two years, to accept the figures of the table as they were, except as regards the cost of the charge per 100 kg. and that of scrap locally available, and this ought also to apply to reclaimable metal in the form of waste, cuttings, risers, runners, deadheads, "drops," ladle slag, metal spilt by splashing, and spoiled castings.

Some would regard the figures given for the weight of the cuttings, runners and risers as being too high, but he would elucidate them with his own experience on the subject. The following results were obtained by him in a series of 41 melts, compared with those in the fourth column of the table showing cuttings, runners, deadheads, etc.

41 melts gave ... ... 93,993 kg.

Castings obtained.		Co-efficients of the German table.	Pigged metal, dead-heads, risers, etc., calculated according to the co-efficients.
Weight per unit.	Weight per group.		
Kg.	Kg.	Per cent.	Kg.
1	5,727	200	11,454
2	8,646	125	10,807
5	13,324	90	11,992
10	23,224	65	15,096
25	32,071	45	14,432
50	54,798	30	16,439
250	22,277	17	3,787
500	14,534	13	1,889
1,000	40,154	10	4,015
2,000	41,032	8	3,283
Total	289,675	—	100,649

As would be seen, the error was only an excess of 7 per cent., which was sufficiently accurate in practice.

During this same series of melts, the melting losses amounted to 15,321 kg., or less than 4 per cent. of the metal charged (403 tons), instead of the 7 per cent. shown in the German table, but to obtain such a small loss it was necessary to use scrap of excellent quality, by picking out castings showing incrustations, burning or excessive rust, and watching the working of the cupola very carefully. If these conditions were not observed it was wise to adhere to the 7 per cent. of the table.

Estimating for Machined Castings.

Up to this point everything was fairly certain. Uncertainty began when to the cost of the metal there had to be added all the other charges up to the delivery of the cleaned castings to the buyer or to another department of the works for which the work was being done. The German Foundry-Owners' Federation recommended the following synthetic formula.

Cost of the metal according to the table ..
Labour: Moulding, coring, cleaning ..
200 per cent. on the preceding figure ..

Total .. ..
15 per cent. on the total .. .. ..

Cost price of the casting .. .. ..

For the selling price a varying surplus must be added according to the risk of spoiled castings. This formula was in itself a great step in advance when compared with the disastrous method of taking a general average. He would now consider the possibility of obtaining a more accurate figure without complicating the calculation. Disregarding machine moulding, which was only applicable to repetition work, and for which M. Rocheport's excellent formula could be employed, he would consider hand moulding, dividing it into two main categories: green-sand moulding and dry-sand moulding. The cost of patterns need not be discussed, as this was always easy to calculate approximately, either for addition to the cost of the casting or to be invoiced separately to the buyer. He would first suppose that there was no coring.

Green Sand Moulding.

The moulding labour should be calculated directly. Two cases might occur: (1) Where the moulding had already been done before; in that case it would be enough to make the work-sheet filled up by the workman himself and checked by the shop manager; (2) where the cost of labour had to be estimated as the work had never been done before; in that case an estimate must be made and the foreman consulted if, as must be presumed, he was a good moulder and knew his men's capacity.

In addition, account must be taken of a large number of supplies and operations; some of these were proportionate to the tonnage, others were due to the difficulties of the casting to be moulded, and were therefore proportionate to the direct labour.

Supplies.

The following supplies might be regarded as proportionate to the tonnage:—Shanks and ladles, their lining and the drying wood; riddles and sieves; bellows; brushes; trowels; baskets; pails and other small material; nails, pins, staples, gaggers, etc.; sand, clay, and their additions as: (1) for similar geometrical castings, the quantity of loam to be used was proportionate to the weight; (2) for castings of the same weight but differing in form, the quantity of sand, clay, etc., was proportionate to the surface.

Generally speaking, except in the case of sheets or plates of smooth metal, the larger the surface the more ramming was required, while the time taken in moulding and finishing was also greater. The sand required was therefore proportinate to the direct labour. A suitable method of reckoning the two ratios was to lump the sand, loam and additions, and even the motive force for the mill, along with the supplies to be distributed *pro rata* over the tonnage, while the wages for handling and transport ought to be added to the group of operations distributable proportionately over the direct labour. The supplies here detailed might be estimated at *about* 2 *Pesetas per* 100 *kg.*

Operations.

The following were, roughly, the operations proportinate to the tonnage; piecework; repair of moulding boxes; labour in preparaing ladles; transport of the metal; filling the moulds; lifting the products and waste; stripping, and transport to the clearing shop.

These operations were at present equivalent to 7 *Pesetas per* 100 *kg.*

The following might be regarded as *proportionate to the labour*:—The sand-preparer's wages and cost of sand transport; the cleaners' wages; the finishers' wages and cost of preparing for casting. In the aggregate these charges were equivalent to 30 *or* 40 *per cent. of the direct labour.*

Overhead Charges.

Still with the view of securing simplicity, and in order that Mr. Runge's 90 per cent. of foundrymen might begin to approximate to accuracy, the overhead charges could be combined as follows:—Salaries of works managers; moulding shop wages; cost of transport and dispatch packing; lighting; warehousing and workmen's insurance (pensions and accidents); fire insurance; salaries of technical and administrative staff; commissions, propaganda, advertising, office staff; rents; depreciation of buildings and plant; rates and taxes; and discounts and interest.

The aggregate of these charges divided by the total of wages paid to the staff of the producing workshops gave a *percentage* which, for the sake of definiteness, he would fix at 80 *per cent.*, and which should be applied to the total direct or indirect labour employed in producing any casting.

Dry Sand Moulding—Supplies.

To these charges there would have to be added: —Blacking, the work of stoving and removing the moulds from the stove, and the fuel required for drying. By adding all these items throughout a fairly long period and dividing by the aggregate weight of the moulds obtained, anyone might calculate the excess or supplement to be added per 100 kg. when stoved mouldings were in question. Unless more accurate details were available it would be well to estimate about 5 *Pesetas per* 100 *kg.*

Cores.

These charges were more difficult to calculate. This could not be done with any great accuracy except by employing a highly detailed system of accountancy. It was easy to estimate the cost of the indirect labour and the supplies relating to the preparation of the sand and its additions, coating, transport, drying and delivery to the moulding department, as also the plates, core-barrels, etc. These operations might be regarded as proportionate to the weight of the cores produced, but they were not proportionate to that of the finished castings. It would, therefore, be an error to allocate them in proportion to the direct labour, but this error was not very great in foundries not doing specialised work. If, however, castings with complicated cores and of light weight had to be produced, and the coring charges were allocated in proportion to a fairly large amount of labour, the calculation would be in excess, but this could be allowed for in fixing the percentage of manufacturing profit on the cost price.

In regard to the requirements of an approximate estimate, therefore he would not hesitate to suggest that these charges should be fixed by a percentage of the direct labour employed in manufacturing and finishing the cores. And unless each works had made the calculation for its particular purposes, 50 *per cent. of the cost of labour and coring* might perhaps be taken without committing any great error, provided the hay rope and chaplets were taken into account, and the price of these accessories, which was easy to obtain, was added to the cost of each casting.

In this way, by adding the percentage for overhead charges (80 or 60 per cent.), a labour item would, of course, also be added, but it would not be important; there was even a compensatory element, for if the mould had to be stoved, the fact that the charges for stoving labour had been included meant that they were deducted from the coefficient of 80 applied to the overhead charges.

All the rules he had sketched out would be elucidated by the following example which he dedicated to those of his colleagues who offered and sold columns at 60 Pesetas per 100 kg. Let them take the case of a column pedestal 1.40 metres in

length and with a diameter from 0.42 to 0.30 metres with shaft 1 x 0.30 metres. Weight with normal thickness: 300 kg.:—

	Ptas.
Moulding labour	22.50
Making and finishing core	10.00
Hay rope, chaplets, etc.	5.15

Without counting the pattern, the price would work out as follows:—

	Ptas.
Cost of metal (Table I)	84.00
Ordinary supplies: 2 Ptas. per 100 kg. ..	6.00
Stoving supplies: 5 Ptas. per 100 kg. ..	15.00
Moulding labour	22.50
Indirect labour apportionable at 30 per cent. on the preceding item	6.75
Indirect labour apportionable on the tonnage: 7 Ptas. per cent.	21.00
Coring labour	10.00
Surplus of 50 per cent.	5.00
Overhead charges: 80 per cent. of the five preceding items	52.20
Hay, rope, chaplets, etc.	5.15
Total	227.60

Cost price per 100 kg., exclusive of moulding, 72.50 Pesetas.

For the sake of analogy, the synthetic formula of the German Foundry Owners' Federation might be applied, adding the dressing and cleaning of the column bases estimated (14 of which were being made at the author's foundry), which cost 5 Pesetas per unit:—

	Ptas.
Cost of metal	84.00
Labour: Moulding, coring, cleaning	37.50
Supplement 200 per cent.	75.00
Total	196.50
Supplement 15 per cent.	29.47
Cost price	225.97

If the 90 per cent. of foundrymen mentioned by Mr. Runge, who either made no calculations or calculated wrongly, adopted one or other of the two systems, thoroughly studied the subject, *not with theoretical reasoning but with figures*, and set themselves to correcting the existing discrepancies in estimating, they would be on the right road. His own aspirations would be realised, for he would have guided their first steps, which were always the most difficult to take. He need hardly add that he was entirely at the disposition of his colleagues, whether members of the Congress or not, to clear up any points that might have been left obscure.

East Midland Section of the British Foundrymen.

Institute Opens Winter Session.

The members of the East Midland branch of the Institute of British Foundrymen are promised a very interesting winter session. The opening meeting is on Saturday, and Mr. H. Bunting, the honorary secretary, has arranged quite an attractive agenda. On Saturday a visit will be made to the works of Messrs. Worthington-Simpson, Ltd., Balderton, near Newark, and the meeting that is to follow has been arranged in conjunction with the Sheffield and West Riding branches of the Institute. The meeting will be held in the works mess room at Messrs. Worthington-Simpson, Ltd., and an address on experiences of Continental foundries will be given by Mr. J. Arnott, of Glasgow. Mr. Arnott will deal with the manufacture and use of plaster patterns and cost, metal-pattern plates and moulting, gating and pouring methods. He will also give some interesting facts with regard to a visit to Messrs. Sulzer Bros., of Switzerland, and tell of the lay-out and equipment as well as the moulding and pouring practice used for Diesel engine castings.

It is hoped there will be a good attendance to welcome Mr. Arnott. Arrangements are being made to convey members to Balderton by road from the various centres.

On October 27 a meeting will be held at Loughborough, when Mr. J. Lucas, of that town, will speak on "Foundry Costing."

War-Blinded Craftsman.

How Help Can Be Given.

Under St. Dunstan's care many men have launched out most successfully into professions, trades, and occupations of which they had no post-war knowledge, and probably no hope of entering. Almost without exception they have "made good" in the widest sense of the term, and to-day are showing in their useful and contented lives how fully they have justified the support the public have ever given St. Dunstan's labours on their behalf.

According to the annual report just to hand, expenditure has exceeded income this year by £5,400, yet the Council express the fullest confidence that the income needed to carry on its work will be maintained and that a sufficient surplus will be forthcoming which will enable them, in accordance with the actuarial report made last year, to set aside a sinking fund which will endow St. Dunstan's at the end of the fifteenth year.

One reason for the adverse balance this year is the increase in the provision of expert supervision for, and the subsidisation of, the blinded craftsmen's trades. "Paradoxically," says the report, "the increase is direct evidence of the success of St. Dunstan's methods, for it is wholly and exclusively direct subsidy on increased trade. In fact, it means that the blinded craftsmen have increased their turnover, their use of subsidised raw material, and the volume of finished articles which St. Dunstan's has to help them to sell by no less a sum than £14,000. Nothing could be better for the men than that they should thus add to their productivity and earning power, for greater activity and more money in the home mean greater happiness and a higher standard of living. St. Dunstan's will make strenuous efforts to maintain unimpaired its services in connection with the men's productive work, but in the face of Indian competition in the mat industry, and foreign competiton in the basket-making and joinery industries, the problem is one extremely difficult of solution."

Here, then, is a means for wholesale and retail traders handling the many classes of goods made by St. Dunstan's men (baskets, mats, trays, nets for every purpose, rugs, and joinery articles, etc.) to help St. Dunstan's to solve this problem by placing orders and giving the public opportunities of buying the goods. Trade terms and fully illustrated catalogues will be gladly sent on request to St. Dunstan's Headquarters, Inner Circle, Regent's Park, London, N.W.1.

Correspondence.

[*We accept no responsibility for the statements made or the opinions expressed by our correspondents.*]

To the Editor of THE FOUNDRY TRADE JOURNAL.

Problems in a Small Foundry.

SIR,—After reading the long and sorrowful letter by "Foundry Owner" I feel I must endeavour to cheer him up, otherwise he will fade away with pessimism.

In the first place, he says the principals of his firm are keen on production, but are not interested in the selling. This, in my mind, is the whole cause of "Foundry Owner's" trouble. If they could reverse their attitude their business would more likely be successful.

The statement made with reference to the great difference in price between the actual cost of certain articles and the prices paid by the consumer is often true, and this will always be the case if sales are organised through merchants.

Without going into details on every point raised, I could give "Foundry Owner" a very satisfactory answer, but I am afraid the Editor could not spare several columns of his paper for this purpose.

I am a foundry owner, and have found no difficulty in producing articles of domestic utility and putting them on to the market, at a lower price than my competitors, and still leave myself a substantial profit.

If I can be of any assistance to "Foundry Owner," I have left my address with the Editor, and I should be pleased to show him some of my methods, or help him in any way that is possible.—Yours, etc., "ANOTHER FOUNDRY OWNER."

Random Shots.

You have doubtless seen in your favourite Sunday newspaper the last six or eight weeks a little notification to the effect that Mr. Blank, who writes your favourite column every week about this, that or the other thing, will not be contributing for a few weeks to come, because he is away on holiday. "Marksman," unfortunately, has no holiday away from his responsibilities, and even in seeking a little light relaxation and entertainment by the sea his mind is full of his obligations.

* * *

It is, of course, very difficult to get down to business when there is holiday in the air. During August the salesman finds as he travels that it is very little use trying to collect orders, because Mr. Dash, Mr. Whatshisname, and Mr. Ican't-placeyoubutIremeberyourfacequitewell are all away. They are on the Continent until the middle of September, and you may look for them at Biarritz, at Ostend, Juan les Pins or Etretat.

* * *

Did you ever hear the story of the man who met an acquaintance whom he had met several times and whose name he should have remembered? He dared not admit his inability to recall it and made an attempt to find it out by inductive methods, for as they shook hands in parting he said, "Excuse me, just how do you spell your name?" The acquaintance smiled as he replied, "The usual way—with an 'E.'"

* * *

Of course, I can reflect on the expensive Continental resorts favoured by many of my acquaintances while I sniff the ozone at Blackpool during a Wakes Week. It was there indeed that I met Albert, about whom more anon.

* * *

Even our most serious friends are not immune from dissipation; when I see, for example, that the Iron and Steel Institute is to visit Spain before the end of this month for their autumn meetings, my mind resolutely refuses to conjure up the visions suggested by Rubio, Bilbao and the like, and prefers to dilate upon mantillas and embroidered shawls, the strains of a dreamy tango, the click of the castanets, the afternoon siesta, and the late long-drawn-out evening meals.

* * *

You have doubtless heard of the influx in recent years into the drapery stores of lordly individuals with University education who make the old-fashioned shopwalker look like a sick headache. They must take other kinds of people as well if we are to believe the story about the waiter who became a draper's assistant. His first client demanded a pair of silk stockings, to which he absent-mindedly replied, "Thick or clear, madam?"

* * *

I notice that a very popular journal now gives as a tail-piece to its weekly film notice the most amusing film caption, an idea which appeared in this column many weeks ago. We are always glad to learn from readers any gems of humour which they may strike, either in the picture theatre, the music hall, or elsewhere. The sign of a good story or line is the desire to tell it to somebody else.

* * *

We cannot offer a prize; your only satisfaction will lie in having your best jokes immortalised in print. This week film sub-titles which struck me as being particularly funny were the following:—

"Sloville was not a slow town; it had stopped."

"The only sign of life was the smoke arising from the crematorium."

* * *

THE ALPHABET.

J is for Jar-ram, a popular toy,
Because so they say in each man lurks a boy.

K is for Knowledge, with which we are stocked,
If you heard the tithe of it you might be shocked.

L is the Ladies whom we all adore,
But not if they get on the foundry floor.

The Measurement of the Cupola Air Blast.—I.

By METER.

The economy of the fuel consumption in the cupola melting is a consideration of first importance in foundry management. To-day, as in the past, any device which claims to effect fuel economy is sure to gain the attention of those responsible for cupola operation. In many ways it is remarkable that in the practice of fuel economy, nothing like the same strict attention is paid to the weight of air used as is given to the coke consumption in the cupola. Yet the most unscientific of foundrymen will admit the simple logic of the fact that the weight of air used is of just as much importance as the weight of fuel used, since both are the two essential components of the combustion reaction which provides the heat for melting. In attempting to consider the reasons for this neglect we are persuaded that the full significance of the importance of air control is realised by foundrymen, and the neglect arises out of the necessity for the use of separate air-measuring instruments occasioned by the almost universal adoption of fan blowers. With blowing machinery of the positive displacement type it is a comparatively simple matter to determine the quantity of air delivered, from the knowledge of the speed of the machine and its displacement capacity. In fact, with such machinery maintained in good condition the air deliveries can be calculated with greater accuracy than is obtained by many of the measuring appliances available to-day. As is well known with fan blowers operating under cupola conditions the delivery depends upon the nature of the resistance offered to the air flow in addition to the speed of the fan. This resistance is of such a variable and incalculable nature in cupola practice that the only satisfactory and reliable method of determining the air delivery lies in the use of some form of separate measuring instrument.

From the foundryman's point of view the principles involved in the construction and use of air-measuring instruments are a matter of considerable complexity, and for the same reasons the instruments themselves are comparatively expensive. Under these circumstances the tendency to neglect air measurement is somewhat natural, particularly in view of the fact that its supply is virtually free of charge, and, unlike the coke consumption, does not make its appearance in the financial balance sheet. On the other hand, it can be conclusively demonstrated that strict control of the air supply, to the previously determined optimum conditions for any particular cupola, involving the use of air-measuring instruments, enables definite economies to be effected. No better example can be quoted than the careful experiments of Piwowarsky and his colleagues. These clearly show the method to be followed in determining the best conditions of air and coke consumption, and these are shown to be of such a magnitude as to be quite equal to the results claimed for many of the special tuyere ratios and forms of construction. Nothing need be added to results of this nature to justify the expense and use of air-measuring instruments in cupola practice. There can be no doubt that the existing condition of air measurement in cupola practice will steadily improve with the more extensive demonstration of the commercial value of air control, and a better understanding of the principles involved in air measuring and the use of air-measuring instruments.

Air measuring Instruments.

The wide variety of methods available for the measurement of air flow can be divided, for our present purposes, into the two broad classifications of direct and indirect methods. In the direct methods the direct weighing or measurement of the volume of the fluid discharge is utilised. The positive-displacement type of blower in itself constitutes such a direct method of measurement, and various types of piston-displacement meters, which bear certain resemblances to such blowers, are constructed for air-measurement purposes. The simplest forms of direct measurement are those in which a tank or receiver of known capacity is utilised. The fluid is either collected or discharged from such a calibrated tank under controlled conditions. These principles are elaborated in the wet drum and bellows type meters familiar in gas-metering practice. Such direct meters are unsuitable for measuring the air delivery to cupolas and are of interest for our present purposes in so far as they constitute the means where indirect types of measuring instruments can be calibrated and standardised.

In the commercial measurement of air supply to cupolas some form of indirect measurement is utilised. Of the various types of such apparatus available the following are available for cupola purposes:—(1) The Pitot tube meters; (2) the Venturi tube meters; (3) the orifice flow meters; and (4) meters depending for their action upon the movement of a controlled paddle placed in the air stream. These meters depend for their action on the velocity of the moving stream, and this velocity being determined the air flow can be determined if the area of the conduit in which the flow takes place is known. All these different types of meters may be considered as being divided into two parts; the portion which registers the condition of the air flow proportional to the velocity, and the actual metering portion which measures these conditions in the desired units.

The Pitot Tube Meter.

The Pitot tube (or tubes) is a very old instrument for measuring the velocity of flowing fluids, devised in the year 1730 by Henri Pitot (1695-1771).* Pitot observed that the level of the liquid rising in bent tubes immersed in flowing streams of liquid varied in accordance with the disposition of the mouth of the tubes in relation to the direction of the flow of the stream. With the mouth opposed to the direction of flow the liquid rises to a height above the stream level and with the mouth facing downstream the liquid sinks to a level below that of the stream level. If the tubes are immersed to a depth X (Fig. 1) in a stream flowing with a velocity V in the direction indicated the difference in level of the liquid in the two tubes H_1 and H_2 is proportional to the velocity of the flowing stream.

If a similar arrangement of tubes is introduced into a current of air flowing in a pipe the difference in pressures is proportional to the velocity, and this pressure difference can be conveniently measured by connecting the free ends of the tubes to the two limbs of a simple U-tube liquid manometer as in Fig. 2. The change in level of the liquid corresponds to the difference in pressure in the two tubes and is proportional to the velocity. These pressures are frequently referred to as the dynamic and the static pressures respectively and the pressure difference is spoken of as the velocity head or velocity pressure.

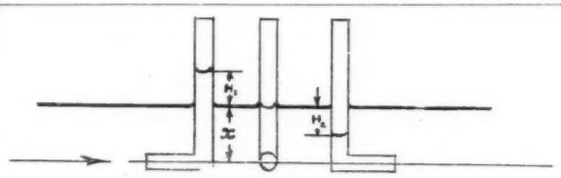

FIG. 1.

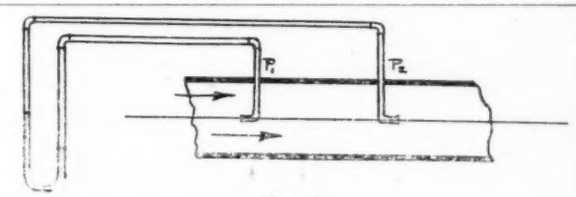

FIG. 2.

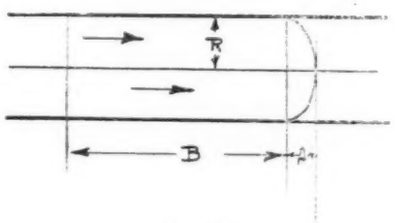

FIG. 3.

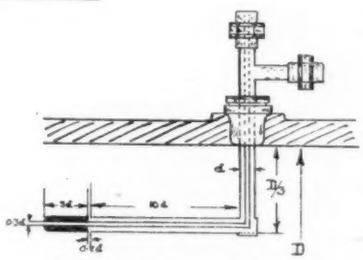

FIG. 4.—PRANDTLE TUBE.

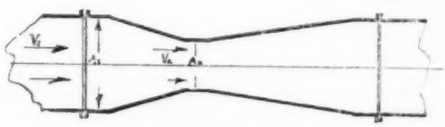

FIG. 5.—VENTURI TUBE.

If P_1 and P_2 = the dynamic and static pressures in pounds per sq. ft. absolute,
V = the velocity in ft. per sec.,
W = the density of air in lbs. per cub. ft.,
G = the acceleration due to gravity,
n = the experimental coefficient,
then the velocity of the flow is given by the relation:—

$$V = \left[\frac{2g}{W}(P_1 - P_2)\right]^{\frac{1}{2}} \quad (1)$$

The difference in pressures $(P_1 - P_2)$ can be noted by the single symbol H, and as this is frequently measured in inches of water equation (1) becomes

$$V = 18.23\, n \left[\frac{H}{W}\right]^{\frac{1}{2}} \quad (2)$$

where the difference in pressure is measured in inches of water.

It will be remarked immediately that the determination of the velocity with tubes of this type is obtained only at a plane in the conduit or pipe corresponding to that passing through the point of application of the tubes. Experiment shows that the velocity of air flowing in cylindrical pipes is not uniform at all points in the cross-section of the area of the pipes. At the extreme inner surface the velocity is less than at the exact centre,

* Histoire de l'Acadamie des Sciences, 1732. Page 236.

a fact which is ascribed to the viscosity and friction of the fluid in contact with the pipe walls. If the velocities are determined at successive radii in a plane cross-section through the pipe the results can be plotted in the form of a diagram showing the velocity distribution across the whole sectional area of the pipe. Such velocity diagrams are known as velocity distribution diagrams or velocity traverses—and experimental investigation shows that the distribution tends to be ellipsoidal; the velocity distribution curve tending to be elliptical in shape under flow conditions in straight lengths of pipes free from the eddying or turbulence set up by bends, valves or other obstructions, to the free flow. The knowledge of the form of the velocity distribution curve enables the relation between the velocities at given radii to be determined, and also the mean velocity of flow in the pipe and its position in the normal plan section through the pipe.

In Fig. 3, where the velocity distribution curve is elliptical, the velocity at the surface is represented by B ft. per sec., and at the centre by (B+A) ft. per sec. Since the mean ordinate of an ellipse is $\frac{3}{4}$A, the mean velocity is represented by (B+$\frac{3}{4}$A) ft. per sec., and in a pipe of radius R this velocity occurs at the distance 0.745 R, being the distance of the mean ordinate from the centre. In the case of a parabolic distribution curve the mean velocity is (B+$\frac{A}{2}$) ft. per sec. at 0.706R, the distance from the centre in a pipe of radius R.

The position of the Pitot tubes in the pipe is of importance in connection with the determination of the mean velocity. This position can be determined either from the velocity traverse curve or the velocity determination at any other position can be corrected by the application of a correction coefficient determined from the traverse curve. The value of the coefficient varies with the ratio of $\frac{A}{B}$. The correction coefficient relating the observed velocity at the centre to the mean velocity is given in Table I for varying values of the ratio $\frac{A}{B}$ and for elliptical and parabolic distribution.

In practice it is generally preferable to measure the maximum velocity at the centre and to determine the mean velocity by applying the correction coefficient determined accurately from the traverse curve. Some authorities recommend the fitting of the Pitot tubes in the pipe at the point of mean velocity and thus reading the mean velocity direct. This position is very approximately given as a distance of $\frac{1}{3}$ of the diameter measured from the inside surface of the pipe.

dynamic tube has a thin-lipped orifice and the outer or static tube has a conical stopped end, small holes being drilled perpendicular to the axis below the cone. A form of tube due to Prandtle is illustrated in Fig. 4, and is designed with spherically-shaped end at the orifice. Whatever form of tube is used it is essential to arrange for it to be inserted into a straight length of pipe. An ideal straight length of pipe is 14 diameters, free from bends, curves or other obstructions.

Venturi Tube, Nozzles and Orifice Plate Meters.

The principle of the Venturi tube as applied to the measurement of the velocity of fluid flow was invented by Mr. Clemens Herschel, U.S.A., and named by him the Venturi meter after an Italian experimenter, who lived in Paris during the French Revolution, and published details of investigations on the flow of fluids in expanding nozzles. The Venturi tube is essentially a constriction in the diameter of the tube, in such a manner that from the original diameter in the direction of stream flow the diameter is progressively restricted to a minimum beyond which the diameter is progressively expanded until the original diameter is regained. This type of tube is diagrammatically illustrated in Fig. 5. The nozzle plate and orifice plates are in reality special cases of the Venturi tube, and diagrams of various forms are illustrated in Fig. 5.

If a steady flow of fluid is imagined passing through a Venturi tube the same weight of fluid must pass each cross section during a given interval of time. If this were not so then the fluid would either accumulate or diminish between any two cross sections. This fact is sometimes referred to as the law of continuity. Very strictly speaking it is only true in the case of perfect flow or perfect stream line flow, in which the stream lines are perpendicular to the imaginary cross sections through the tube. Stream line flow is the characteristic flow of a perfect fluid, which is defined as a fluid free from viscosity. In the steady flow of such a fluid it can be imagined to be divided into infinitely small tubes of flow, in which the particles trace out a line of flow uniformly and continuously in the direction of the flow. Such stream lines may be straight or curved according to the direction of the flow. The effect of viscosity in the fluid is to render the motion of the particles irregular or eddying under most ordinary conditions.

In the case of an incompressible fluid flowing in a Venturi-shaped tube the quantity passing the constriction or throat as it is termed will be the same as the quantity passing at the inlet in a given space of time. At the throat, therefore, the velocity of the flow must be greater than at the

Table I.

Elliptical Distribution.

Ratio $\frac{A}{B}$ ..	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0
C=$\frac{\text{V. Mean}}{\text{V. Max.}}$	0.970	0.946	0.924	0.904	0.890	0.875	0.864	0.854	0.842	0.833

Parabolic Distribution.

Ratio $\frac{A}{B}$ ..	0	0.429	0.815	1.49	2.98	8.84	8
C=$\frac{\text{V. Mean}}{\text{V. Max.}}$	1.0	0.90	0.85	0.80	0.75	0.70	0.66

In addition to the correctional coefficient for the position of the Pitot tube a further discharge coefficient which is determined by the particular form of the tube, its dimensions and character of finish. This discharge coefficient must be determined by the experimental calibration of the tube.

The Pitot tube is very convenient for industrial use in that no great modification in the pipe line is necessary. The tubes are generally designed to be inserted through a single hole drilled and tapped into the main. Most designs of tubes endeavour to combine the two tubes into a single tube for this purpose and to shape the edges at the pressure inlet to prevent losses due to eddying or irregular disturbances in the air current. In the National Physical Laboratory pattern two brass tubes are arranged concentrically, the inner or inlet in the ratio of the areas of the throat and inlet. If the velocity at A_1 and A_2 are V_1 and V_2 respectively, Fig. 5, then the quantity of fluid passing A_1 is ($A_1 \times V_1$) and that passing A_2 is ($A_2 \times V_2$) from which we have the relation:—

$$(A_1 \times V_1) = (A_2 \times V_2)$$

and

$$\frac{V_1}{V_2} = \frac{A_2}{A_1}$$

in which the change in velocity is proportional to the change in area becoming greater as the area becomes less. The increase in velocity at the Venturi throat corresponds to an increase in kinetic energy, and since the total energy passing each cross section in unit time is the same this increase is at the expense of the potential energy, and is therefore accompanied by a drop in pressure at the throat.

World's Largest Silver Bell Presented to H.M.S. "Nelson."

A silver bell has been presented to H.M.S. "Nelson" by the people of the Tyneside to commemorate the building of H.M.S. "Nelson" at Newcastle.

The bell, which is 19 in. high and 24 in. in diameter, whilst the clapper is also of solid silver 3 in. in diameter, constitutes the largest silver bell yet cast. The casting, machining, etc., was carried out by Messrs. J. Stone & Company, Limited, founders, of Deptford, London.

This bell was presented last Saturday at the Town Hall, Newcastle, and carried on a gun-carriage to the quay side, then conveyed up river to H.M.S. "Nelson" at Jarrow Slake.

The presentation was made by Mr. A. W. Lambert, in whose Lord Mayoralty in 1927 the fund was started, the originator of the idea being Mr. Clarence Smith, chairman of the Consett Iron Company and a director of Smith's Dock Company, Limited.

The World's Largest Silver Bell, Cast in the Foundries of J. Stone & Company, Limited, Deptford.

Mr. Lambert said they were proud of the "Nelson," not only because she was a mighty warship, but because she was an outstanding production of Tyneside work.

The bell was accepted by the Commanding Officer of the "Nelson," Captain S. J. Meyrick, who said it was a wonderful present. Officers and men of the "Nelson" would change, but the bell would remain in the ship as a permanent tie with Tyneside. The "Nelson" was one of the two biggest battleships afloat in the world. Battleships were the backbone of the Fleet, and without them in wartime all other units would crumple. So long as vessels kept the seas battleships would be a necessity.

Admiral Sir Hubert Brand, Commander-in-Chief of the Atlantic Fleet, also spoke a few words of thanks.

At the close Chief Petty Officer Callaway sounded Eight Bells on the silver bell.

Details of Manufacture.

The first step towards the manufacture of a casting is the pattern work, and in this case the mould and core of the bell was struck up in special loam, by the means of a striking-up board. These boards are made to suit the contour of the outside and inside of the bell, and are attached to a revolving spindle.

The mould is then prepared on a plate roughly to the shape of the bell, and the striking board

(*Continued on page* 216.)

Non-Ferrous Metals in the Shipping Industry.*

By F. G. Martin, B.Sc., F.I.C.

Until a comparatively recent date the metallurgy of the ferrous metals almost entirely overshadowed that of the non-ferrous metals. In the earlier days of steam propulsion the non-ferrous metals in use were almost exclusively copper, its alloys gunmetal and brass, and bearing alloys and zinc, and these were largely taken on trust or at best subjected to mechanical tests.

The rapid stride in the efficiency of the marine engine and its auxiliaries not only called for higher duty from its material of construction, but demanded newer and better ones, with the result that to-day, although the main interest still centres about steel and iron, the range of non-ferrous metals called into service has greatly extended, and there is hardly any of the commercial metals or their alloys which do not play some part in the construction of the modern ship and its engines. Even the precious metals, such as gold, platinum and silver have their uses, small it is true, but it is interesting to note that a Liverpool firm actually used in one year twenty thousand ounces of silver for the construction of its engines.

It is not too much to say that if it had not been for the metallurgist, and largely for the non-ferrous metallurgist, the modern engine would not have reached its present high perfection, or it would have been attained at much greater expense. One can almost trace the development of engineering side by side with that of scientific metallurgy, one might almost say with the birth and development of the Institute of Metals. At times new discoveries in metallurgy have been followed by their adoption by the engineer, at others the engineer has called for metals or alloys to meet special contingencies, and as a rule the metallurgist has supplied the want.

To develop this subject it is proposed to take as a model an ordinary cargo boat, 450 ft. long, 60 ft. beam, 35 ft. depth moulded, and capable of carrying approximately 10,000 tons deadweight. The total amount of steel in the hull of such a vessel would be approximately 3,500 tons, with some 50 tons or so of steel castings (as stern frame, spectacle bracket, etc.).

A cargo boat of the dimensions given would normally be propelled by engines of approximately 6,000 h.p. This power can be developed in one of three ways: Reciprocating machinery; turbines; Diesels. In the case of reciprocating machinery there will be: 124.35 tons cast iron; 40.2 tons steel, cast and forged; 5.8 tons yellow metals; 1.9 tons white metals, or expressed as a percentage, 70¾ per cent. cast iron; 23 per cent. steel, cast and forged; 3¼ per cent. yellow metals; 1 per cent. white metal in a total weight of 176 tons (in which boilers, etc., are not included). For turbines of the same horse-power there will be: 39.55 tons cast iron; 22.95 tons steel, cast and forged; 0.75 tons gunmetal and other yellow metal; 0.15 tons white metal; 3.5 tons blading material, which, expressed as percentages are: 58 per cent. cast iron; 33¾ per cent. steel, cast and forged; 1 per cent. gunmetal and other yellow metals; ¼ per cent. white metal; 5 per cent. blading material, in a total weight of 67 tons. Boilers, etc., are not included in these figures. In a Diesel engine of approximately 6,000 h.p., taking in the main engines, auxiliary engines and other fittings, there will be about: 580 tons cast iron; 770 tons steel; 55 tons brass and other yellow metals; 7 tons white metal. Expressed as percentages, these quantities are: 41.1 per cent. cast iron; 54.6 per cent. steel; 3.9 per cent. brass and other yellow metals; 4 per cent. white metal, in a total weight of about 1,400 tons.

With the introduction of the Diesel engine as a means of propulsion of ships there has been developed the electric winch, with the result that, on the typical cargo vessel previously referred to, there will be approximately 20 winches, which, with their motors, etc., will absorb 15 tons of copper and one ton of phosphor bronze, gunmetal, etc., with about 1 ton of copper busbars, brass fittings, etc., on the switchboards, and there will be approximately 25 miles of electric cables, weighing about 30 tons.

Sea Water Most Powerful Corrosive.

After many years' experience of ships, that, given plenty of it, and for long enough, the most powerful corrosive agent on the face of the earth is sea water.

The increasing use of fuel oil, whether in the internal combustion engine, or whether burned in boilers to raise steam, has brought with it quite a number of troubles, many of which have yet to be solved.

The ordinary electric cable as supplied to ships consists of an internal core of copper, which is surrounded by rubber as an insulating medium. But, because the rubber contains considerable quantities of "fillers," including sulphur, it is necessary to protect the copper from its action, so the copper strands composing the inner core have to be tinned. Outside the rubber insulation come layers of lead and braid, and, finally, steel wire. Such a structure does not lend itself to acute turns round corners and over frames. It does not stand the test of age and, worst of all, it rapidly deteriorates under the influence of fuel oil, which it meets particularly in the way of the machinery.

A successful solution of this difficulty has been reached by two Liverpool men, in the substitution of a cellulose product for the rubber, thus eliminating the necessity for tinning the copper and for using lead sheathing. The resultant cable is much more flexible and can be turned back on itself without fracture, and, above everything, is particularly resistent to the action of fuel oil—in fact, prolonged immersion in fuel oil appears if anything to increase its efficiency.

The exhaust gases from a Diesel cylinder are at a very high temperature, and are consequently very chemically active, and many efforts have been made to deal successfully with the wear and tear on the exhaust valves. Here nickel particularly has played its part.

Dr. Rosenhain has stated (J. Inst. Met. 1926, pp. 7/8): "This process of development by trial and error, by the observation of accidental happenings and, very occasionally, by deliberate introduction of new ideas taking place over hundreds or even thousands of years, and engaging the minds and activities of a multitude of workers, has led to the accumulation of a great mass of skill and experience. An industry developed in this way is full of special and often more or less secret processes. Parts of these are essential to success, while others may be entirely unnecessary or even detrimental. Those who practise the art, however, cannot discriminate between the necessary and the unnecessary, as they have no basis of general knowledge upon which to form such a judgment. None the less, within the limit and scope of what has actually been achieved, the art developed by such a process attains a considerable degree of perfection."

These remarks apply with special force to the world of shipping. In every industry the aim of the technician is to secure a combination of strength, safety in use, resistance to wear and corrosion, lightness and convenience at the minimum cost of time, space and money. Vastly different working conditions compel each branch to strike its own balance between these qualities; and nowhere is the incidence of conditions more complicated and more pressing than is shipping. To meet this we have, in the first instance, a vast mass of that technical experience, largely unrelated to that of other branches, to which Dr. Rosenhain has referred; experience won in the hardest of schools; and marine history before, during, and since the late war has repeatedly shown us capable of rising to meet unexampled emergency. But much of this experience is uncorrelated and cannot be applied direct to the conditions which have produced it, and to the calling whose glory it is. Consider, meantime, the demands on the shipowner. He is responsible for the safe and rapid transport of both passengers and cargo amid constant problems of loading, handling, storage, preservation and general safety and comfort, and this frequently on the grand scale. In proportion as he grapples adequately with these questions, his technical difficulties multiply. Between him and our many technicians whose knowledge awaits correlation, the metallurgist affords the necessary point of contact.

Propeller Blades.

Now in shipping the problems of wear and corrosion assume relatively enormous proportions; and it is often on this account that non-ferrous metals and their alloys have replaced iron and steel. The classic instance is that of the propeller, which was generally of cast iron or steel in the earlier steamship days. Such, however, was the damage through corrosion and erosion that the experimental substitution of brass for iron took place at an early stage with most gratifying results, speed as well as durability being markedly increased. Since that time the brass propeller has become practically universal, such further improvements as have been introduced being those of detail rather than of type. We have here simply the replacement of a material which could not stand up to working conditions by one which could; but even here a considerable amount of metallurgical knowledge was involved. Cast iron had considerable strength, but was very brittle under certain conditions; it had great hardness, medium specific gravity, and great corrodibility. What was wanted—and what was very quickly forthcoming—was a material having, again, considerable strength, and specific gravity not too far removed from that of iron, little or no corrodibility, and sufficient hardness to withstand erosion, without the presence in excessive amounts of any brittle constituent such as occurs in low-grade cast iron. What is desired in the case of a propeller metal is that it be stiff in the sense that it will not whip, but it must not be so stiff that if it should hit submerged wreckage it will snap off short like a carrot. At the same time it must be ductile, ductile enough to yield to a certain extent to contact with undesirable and misplaced solids, but not ductile enough to bend enough to foul its own rudder. So that a compromise between the two has to be found, and this can best be achieved by the use of a mixture giving a structure with mechanical tests very roughly as follows:—

Mercantile Marine Propeller Metal.

	Approximate Composition.	Typical Analysis.
Cu ..	59—60%	59.64%
Zn	35—37%	36.15%
Fe ..	1%	0.91%
Mn ..	1—2%	1.56%
Al ..	2%	1.74%
		100.00%

Mechanical Tests.

Ultimate Strength	33 tons/sq. in.
Elongation in 2 in.	28 per cent.

A slightly stiffer blade, with rather less elongation, can be obtained as follows:—

Admiralty Propeller Metal.

	Approximate Composition.	Typical Analysis.
Cu ..	56—57%	55.62%
Zn	40—41%	41.90%
T	1%	1.08%
Fe ..	1%	0.91%
Mn ..	0.25—0.5%	0.25%
Al ..	0.25%	0.24%
		100.00%

Mechanical Tests.

Ultimate Strength	36 tons/sq. in.
Elongation in 2 in.	25 per cent.

It is obvious that the previous type of brass most suitable for use in this capacity must have formed the basis for a great deal of research, and even at the present time investigation is constantly being directed to such modifications of the original 60/40 brass as seem likely to increase any desirable quality of propeller metal without unduly detract-

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* Abstract of the Seventh Autumn Lecture read before the Autumn Meeting of the Institute of Metals.

ing from the rest. The general tendency appears to be to increase hardness and toughness by the addition of small amounts of such metals as manganese and nickel, which do not form a separate hard constituent, rather than such hardening agents as tin and iron, which frequently do.

The study and control of casting conditions, by the increasingly close co-operation of foundry and laboratory, have largely eliminated from propeller metals such defects as porosity and oxide films and have gone far to ensure a strong and finely-grained structure rather than a coarse and brittle one. We have in the propeller a problem which may be regarded as practically solved.

Gunmetal.

Special types of the bronzes are gunmetals, and these find much application in a ship for liner work.

Admiralty Gunmetal.

Average Mechanical Tests.

Ultimate Stress	16 tons/sq. in.
Elongation in 2 in.	14 per cent.

Gunmetal (copper 88 per cent., tin 10 per cent., zinc 2 per cent.) is the most usual material for this purpose. Now, in the making of gunmetal castings we have an instance of tried and most welcome practical help from the metallurgist to both brass-founder and engineer. I refer to an important Paper published in 1917 in the Journal of the Institute by Dr. Carpenter and Miss Elam and generally recognised as part of the fundamentally important literature on the subject. In it are investigated and clearly described the correct conditions for casting gunmetal and the defects likely to occur through faulty materials or wrong practice; the whole Paper is an outstanding example of direct help with practical problems, which is the result of careful laboratory research combined with a thorough grasp of practical consideration.

Neglect of proper casting conditions may often have very serious results, even in metal of normal composition.

Bearing Metals.

It is almost universally agreed that a bearing metal should consist of relatively hard particles embedded in a softer matrix—the latter minimising the effect of vibration and shock, while the hard wear is taken by the former. It is further believed very generally that the process of lubrication involves some interaction between the oil and the material of the bearing. Beyond this point we meet widely differing opinions on the mechanism of the process and the actual part played in it by the different constituents of the alloy.

The most generally satisfactory type for marine work is a tin-base alloy containing antimony and copper, of the composition used by Rosenhain and Fry in their valuable investigation of the properties of bearing metal.

Tin-base White Metal.

Analysis.—Sn, 86; Sb, 9; and Cu, 5 per cent.

We have here a reasonably soft matrix, containing two types of hard constituent—the cubical crystals and the tin-antimony compound and the needle-shaped copper-tin crystals. The latter are the first to solidify from the molten state, and by then forming a solid network they keep the grain fine and the distribution of the other constituents even, given proper casting conditions. If conditions are improperly controlled, we get the harder portions segregated. Fusion begins in this material at about 238 deg. C. In cases where lubrication has been careless, or from any cause has failed, we may even get evidence of local fusion and re-crystallisation.

The general experience in marine work emphatically discourages the use of the more fusible bearing metals, especially those of the lead-base type.

Lead-base Bearing Metal.

Analysis.—Sn, 8 to 9; Sb, 16 to 17 per cent.; Cu, trace; and Pb, 74 to 75 per cent.

Fusion in this material, where lead and tin are both present in quantity, begins rather above 182 deg. C., but the alloy is in any case dangerously soft much below this temperature. In the case of a failure quoted, where the tin-base alloy showed signs of local fusion merely, this metal would have left the bearings for good.

Lead-Antimony Bearing Metal.

Analysis.—Sn, trace; Sb, 21.2; Cu, 1.4; Fe, 0.04; Ni, 3.8 per cent.; Zn, trace; and Pb, 73.6 per cent.

The next sample has for its background the eutectic of lead and antimony, which while less fusible than that of lead and tin, is still unduly soft for heavy work, the solid solution of nickel in copper being actually the hardest component present in any appreciable quantity. Such an alloy is scarcely hard enough for heavy duty in the main bearing of a marine engine, though for smaller bearings it might prove more suitable. This specimen was taken from the H.P. crank-pin bearing in a marine reciprocating steam engine and was found satisfactory.

In view, however, of the conditions under which marine bearings work and in which they must sometimes be fitted, the "plastic" bronzes and other alloys of the harder and less fusible type are unsuited for this work. It is obvious that in a problem such as this, and where the conditions can only be fully appreciated by the man on the spot, and in which lubrication practice is involved as well as the selection and proper use of materials, the metallurgist must closely co-operate with the engineer, and the more careful the latter's observations and records, the easier will be the task of the metallurgist, and ultimately, in consequence, the engineer's own. In this department record keeping is not on the same high level as in the case of fuel consumption or condenser practice; the point of making such records is, of course, less immediately obvious than in the other instances, but so much remains to be learned about both wear and lubrication that such notes could not fail to be of great service.

It must also be borne in mind that the question of cost has something to do with the selection of a white metal.

Turbine Blading.

The high-speed ship has made an economical proposition by the introduction of the steam turbine, and it still depends for its success on this feature. Although the Diesel engine has latterly entered this section of marine engineering and appears capable of producing encouraging results, the turbine maintains its pre-eminence. This calls for blading made of material which at the steam inlet end can stand up for long periods to the effect of the high temperatures brought in by the extended use of superheating, coupled with the stresses brought about by high rates of revolution and other service conditions, which all show a tendency to become more exacting in modern specifications. The *King George V* operates on turbines with a temperature of 750 deg. F. at the steam inlet, and a rate of 6,000 revolutions per minute in the high-pressure turbine.

There is small need to go into the details of the materials used in blading, which still are, in spite of the attacks of stainless steel, almost entirely non-ferrous. They include such diversified items as 96/4 cupro manganese and Monel metal for h.p. stages, and brasses, including 70/30 for intermediate stages and low-pressure ends. The failure of blading is only rarely to be attributed to faulty material—*i.e.*, to material which is either intrinsically unsuitable, or which has been worked up from unsound ingots, or which has been improperly treated either mechanically or from the temperature point of view.

It may appear a simple matter to attach a row of blades of perhaps an inch in length, as at the inlet end of the h.p. turbine, in such a manner that it is free from the possibility of the incidence of undue stress as the turbine works up with gradually rising temperature, bringing in the effect of differential expansions, to its running speed of three or four thousand revolutions per minute. It is, however, more difficult to be equally sure of the blading at the other end of the turbine, where the length of twelve or fifteen inches or more introduces a tendency to whip and lag, and where, with the greater diameter of the rotor, the peripheral speed is greatly increased, although the temperature rise is comparatively small. These constructional difficulties, together with those introduced by the erosive and corrosive action of the energy member, have been very largely overcome, and marine engineers responsible for construction, no less than the inventors of the different turbines, are to be congratulated on the successful service obtained in this field from the non-ferrous metals.

Condenser Corrosion.

The marine condenser brings us face to face with widely and frequently varying conditions of wear. A condenser is constantly taking through its tubes sewage effluents, sand, mud, clinkers, and, what is worse, estuary water—in other words, diluted sea water, which is perhaps more actively corrosive than pure sea water. Perhaps nowhere else does the metallurgist come into more direct conflict with the engineer. Both realise that the apparatus shows a distinct temperature gradient, demands a high thermal conductivity, and offers a set of working conditions which it is very difficult either to isolate or to vary at will; these variations are part of the marine engineer's purgatory. The metallurgist is rather inclined to lay special stress on the engineering aspects of the problem—he is tempted to attribute many of the long list of failures to faulty design.

On his side, the marine engineer feels constrained to wonder why the perfect material—incorrodible, inerodible, reasonably light, not too hard, but hard enough to conduct heat perfectly, and possessing the desired degree of rigidity—is not at this time of day forthcoming at a reasonable price. So between our two experts there prevails a state of acute criticism which is not only healthy, but desirable. Anything like constructive criticism is always helpful and often infinitely suggestive. Co-operation is as essential as criticism and, in connection with the corrosion problem, is vital. The metallurgist whose work is concerned with shipping problems has to bridge the gulf between the corrosion research man—who revels in local electrolytic action, oxygen concentration cells, and peptisation—and the marine engineer, at sea in both senses, struggling with a leaking condenser. It is evident that here the co-operation must involve to a great extent that necessary factor, the owner. It has already been noted that working conditions in the marine condenser are extraordinarily difficult either to isolate or to reproduce; we must therefore carry out our tests in an actual run on a real ship, if the owners will let us. It is gratifying to note that they frequently will and do, with highly instructive results; but the latter are merely the coping stone, or the lid, as the case may be, on years of previous research—on the mechanism of corrosion; on its special incidence under particular conditions, so far as these can be stated—on the reviewing of the commercial possibilities and impossibilities of the job, for instance, an alloy of platinum and iridium would make wonderful condenser tubing with proper treatment, but it costs about £25 an ounce; on the production of selected alloys; and on the necessary testing prior to their experimental run on the engineering scale. All this, the sum of many men's work, is based throughout on the published results of the laboratory worker, which this Institute has done so much to render generally accessible. And it is paralleled by the vast experience of the engineer.

Condenser design has made relatively little progress of late years, at any rate from the preventive standpoint. In this connection, reference may be made to a valuable system of observation in use in many ships, whereby the position of each unsatisfactory tube, and of the points on the tube where failure occurred, are regularly recorded on standard plans. When sufficient records of this type are available they may supply information of great value.

The next alternative is hopefully to fit fresh tubes in place of the failures and trust that this time they will not corrode—a method, in short, of vain and ruinously expensive repetition, for which this Institute can hold no brief.

The earliest tubes used in condensers were 70/30 brass. The main conditions in condensers are temperature gradient, flow of sea water, and much more which apparently no one completely understands. If any single theory of corrosion, electrolytic or otherwise, is correct, then as these conditions are always present, every tube ought to corrode. This is not so, because most of the

superintendent engineers in Liverpool could on demand produce condenser tubes of from twenty to twenty-five years' standing, which have not corroded. They have merely suffered from ordinary wear and tear and in some cases are getting a trifle thin.

But the problem is so serious that some other solution had to be sought. There followed the "Cumberland Process," the idea of which of course was based on a definite theory—still unknown, and which was therefore only partially successful.

Then the metallurgist got busy and proceeded with the evolution of copper nickel alloys. These have been found to be at least partially successful, but apparently the degree of success is intimately associated with the concentration of nickel, and with increase in concentration of nickel there comes increase in difficulty of working, which is keeping the tube-maker very busy trying to reconcile his costs with his selling price. Doubtless in time the metallurgist will come out on top and these alloys will take the place that they deserve.

In the meantime the seriousness of the corrosion problem has driven the marine engineer to seek relief in other directions. Such things have been tried as coating the insides of tubes with such substances as bitumastic, but here, while considerable relief was given to the corrosion evil, there was a marked loss of heat conductivity, and once again the marine engineer was left to weigh up on his own account the pros and cons. of the situation. Next, a suggestion has been made to use pure nickel, and such tubes are in use, and the production of nickel has made such rapid strides of late that its increasing possibilities must be of the first importance, and here we have another example of the metallurgist having shown the way to new commercial uses and cheaper production.

Various other attempts have been made to use the standard type of brass tube, but to render it incorrodible by the deposition of a thin impenetrable layer upon its inner surface. The nature of the protective layer has varied greatly. An early suggestion was to form a film resembling as closely as possible the actual deposit which is found on the surfaces of a corroded tube. Another notion was to oxidise artificially the inner surface. Neither method gave results of any practical value, partly on account of the difficulty of forming a uniform and regularly coherent coating on the tube, but their results were valuable in directing attention even more closely than before to the interior finish of the tubes.

The latest attempt to fight this corrosion disease has been by the deposition of metallic chromium on the inside, or sea water side, of the condenser tube. This method has presented its difficulties, but apparently the metallurgist has been able to overcome these, and a tube so plated is now on the market. It also has the additional advantage of possessing, at the normal temperatures of condensers and at the normal water speed of about five or six feet per second, a marked increase in conductivity for heat, of the order of 20 per cent. Marine engineers will watch the progress of this tube with marked interest, and once again it is pleasing to announce that it was the result of the labours of two Liverpool men.

The Pendulum.

BY "ONLOOKER."

Among the hundred and one best "recipes" for successful metal buying, the simple art of watching the swing of the pendulum sometimes goes almost unnoticed. The speculator, of course, has no use for such an old-fashioned piece of mechanism as a pendulum, and pins his faith to rumours of the wilder and more extravagant sort with their promise of big money in a very short space of time. To the more serious-minded student of metal-market movements these speculative outbursts are apt to prove disconcerting phenomena, for they have an awkward knack of cropping up unexpectedly, and, temporarily, at any rate, obscuring the true course of events. On the other hand, it is not wise to allow the bogy of speculation to possess the mind unduly, for many a rise in values fully justified by economic conditions has been launched by a burst of buying largely speculative in character.

Buying on the pendulum method calls for a certain amount of pluck and confidence, for by the time the pendulum, which is, of course, the quotation, state of trade, or consumptive demand, in accordance with the scheme upon which the buyer is operating, has swung to its lowest point, there is precious little optimism left to give point to a purchase. Getting in at the bottom is notoriously difficult, and although the method here advocated of waiting for, or rather counting upon, a reaction is sound in essence, the scheme provides no divining rod for estimating just when the lowest point has been reached. Action and reaction are the weapons which the successful speculator uses to aid his wits in the battle against economic forces, but in employing them he puts into his endeavours every ounce of judgment he possesses. So with the legitimate market operator. Every check on a sagging quotation does not mean the bottom of the fall, nor does a halt necessarily indicate that the upward movement has spent itself.

Appraising Values in Excited Markets.

Correct judgment is usually easier during a period of stability than in the course of a transition from one level to another. Hence the wisdom of endeavouring to estimate the extent of the swing before the pendulum is launched on its course. Such prevision may, of course, prove to be faulty and circumstances compel a recasting of ideas, but it does at least give a "dimension" to the swing of the pendulum, and make for clear thinking amidst the hurly-burly of excited markets. Perhaps nothing is quite so infectious as market sentiment, and it is fatally easy to become the prey of those day-to-day changes of sentiment which create for a short time—sometimes only a few brief hours—tendencies which seem to point very definitely in a direction contrary to that decided upon at the beginning of the pendulum's swing. In such circumstances the only thing to do is to "sit tight," and if the trail is a false one evidence to that effect will soon be available.

In essence the pendulum is a leisurely piece of mechanism, and in market operations based on its principle undue haste is to be deprecated. The infinitesimal check at the end of each swing, evident in close observation of a clock's mechanism, is almost invariably magnified in the metal-market equivalent to a quite appreciable halt or steadying of the quotation, which gives time to the operator to judge for himself whether the influences that have been compelling the rise or fall are spent. Weeks may, of course, elapse before another movement is begun, and if the gap be long enough, it may be that a movement entirely unconnected with that immediately preceding may develop. In other words, an interval following a downward tendency may end with the beginning of a further descent of the pendulum, which will, in due course, create sufficient reserve of energy for a swing upwards.

Infallibility cannot be claimed for any market "system," but the pendulum is brought into this short note on price vagaries more as an illustration of a principle than as a method that will break the bank in record time. Taken as a golden rule over a period of years, the writer believes it to be the best thing of its kind available, and more capable of withstanding the uncertainties and erratic movements created by metal-market cross-currents than any other scheme. In effect the pendulum method says, "buy on the breaks and sell on the rises," but very few people have the courage to do so unless they have formed the habit of watching the swing of the market pendulum.

Chromite in Central Anatolia.—A Swedish consortium has applied for a Government concession to exploit the deposits of chrome ore near Eski-Shehir and other localities in the same neighbourhood. The ore is reported to carry from 43 to 50 per cent. of metal. Some of the ore bodies are close to the Anatolian railway, and will be less costly to transport than, for instance, the ores mined by the Röchling concern, near Dagh Ardy, which has to be carried on donkeys and carts.

Third Empire Mining and Metallurgical Congress, South Africa, 1930.

The Secretary of this Congress (100, Fox Street, Johannesburg) has sent us the subjoined draft of a preliminary circular, which when printed will be sent to all individual members of the constituent bodies of the Empire Council of Mining and Metallurgical Institutions. An abridged text of the circular follows:—

The Prime Minister of the Union of South Africa, General Hertzog, has issued a cordial invitation, on behalf of the Union Government, for the Third (Triennial) Empire Mining and Metallurgical Congress, to be held in South Africa in 1930. This invitation was personally announced by the Minister of Mines and Industries, to the Second Congress assembled in Montreal, Canada, in August, 1927, and has been gladly accepted by the Empire Council of Mining and Metallurgical Institutions, on behalf of the ten Constituent Bodies (see below).

A strong and influential Executive Committee has been appointed by the South African Constituent Institutions, and an attractive programme is in course of preparation. The Congress will commence in Cape Town on Monday, March 24, 1930.

A tentative itinerary has been arranged comprising visits to all the principal mining centres in the Union and Rhodesia as well as places of scenic interest. Those attending the Congress will have the opportunity of visiting the diamond mines at Kimberley, the gold mines and works of the Witwatersrand, the gold, diamond, platinum, coal, asbestos and copper mining districts in the Transvaal, and the Sabie game reserve. The Rhodesian tour will include the Victoria Falls, one of the great natural sights, gold, copper, zinc-lead, asbestos and coal mines, and the Zimbabwe ruins. Members will also be enabled to visit the coalfields of Natal as well as some of the beauty spots of that province and the port of Durban, returning to Cape Town by a circuitous route which will take in Bloemfontein, Port Elizabeth, Oudtshoorn (Cango Caves) and the Knysna Forest. Opportunities will also be afforded of visiting some of the more important industrial developments throughout the country.

Sessions will probably be held in Cape Town, Kimberley, Johannesburg, Bulawayo and Durban. The itinerary, as planned provisionally, will occupy 47 days, the whole distance being a little over 7,000 miles: special trains will be provided by the South African Railway Administration. While, at present, it is not possible to mention any definite amount, it is hoped that the total inclusive cost of the tour will not exceed £140. The Union Castle Mail Steamship Company, Limited, have intimated that they will allow a special rebate of 20 per cent. off the tariff fares, and it is anticipated that similar concessions on rates over other steamship lines will be granted.

The Executive Committee propose to issue, from time to time, circulars dealing with the details of the programme and pamphlets or brochures containing descriptions of the places on the route of the tour. In the meantime it is hoped that all those members of the Constituent Institutions who are in a position to do so, will advise the Secretary as early as possible of their intention to attend the Congress. By doing this they will greatly assist the Committee in their work of preparation as well as afford a guide in estimating the number of delegates who may be expected.

The constituent bodies of the Empire Council are:—(1) The Institution of Mining and Metallurgy. (2) Institution of Mining Engineers. (3) Institution of Petroleum Technologists. (4) Canadian Institute of Mining and Metallurgy. (5) Australasian Institute of Mining and Metallurgy. (6) Chemical, Metallurgical and Mining Society of South Africa. (7) South African Institution of Engineers. (8) Mining and Geological Institute of India. (9) Iron and Steel Institute. (10) Institute of Metals.

Boulton Bicentenary.

Father of Modern Industrial Organisation.

By T. B. Fowler.

No name is perhaps more deeply graven in the history of the foundry trade than that of Matthew Boulton, the great Birmingham captain of industry, whose bicentenary occurs this month.

A native of the Midland capital, born in September, 1728, Boulton stood in the first rank of industrial pioneers. Gifted with a special genius for organisation, he gave an early manifestation of his qualities in his father's business as silver stamper and piercer, which he transformed and extended.

A year after his father's death he married Anne Robinson, of Lichfield. He received with his wife a substantial dowry which he used further to extend his business by the establishment of the famous Soho Works, on what was then a barren heath situated some two miles from the centre of Birmingham. The only habitation in the district at the time was a warrener's hut, which stood on the bleak and barren summit of the hill, but around Boulton's works there presently grew up the teeming industrial district which has ever since retained its fame in industrial production.

Artistic Productions.

Boulton's earliest efforts were devoted to the manufacture of inlaid steel buckles, buttons, watch chains, trinkets, etc. Up to this period Birmingham had had an unenviable reputation for gimcrack wares. It was Boulton's aim to remove the reproach. "The prejudice," he wrote, "that Birmingham hath so justly established against itself makes every fault conspicuous in all artfcles that have the least pretentions to taste. How can I expect the public to countenance rubbish from Soho while they can procure sound and perfect work from any other quarter?"

An artist himself to the finger tips, he was not content with his own designs, but employed agents to scour the markets for the best examples of art work, not only in metal, but also in pottery and other materials, and from these he drew the inspiration which enabled him to achieve the highest standard of artistic merit in his manufactured articles.

It is recorded that the products of Soho were exported to France in large quantities, "where they were reproduced with avidity by the English beaux as the offspring of French ingenuity."

Boulton's success was accentuated by his invention of a new mode of inlaying steel, and his factory grew so rapidly that he was compelled to look around for fresh sources of power. So far he had been dependent upon water augmented by horses. He experimented with a steam engine of his own construction, but nothing came of it. James Watt was then vainly endeavouring to perfect his famous engine. The inventor had been brought under Boulton's notice by Roebuck, who was in partnership with Watt, but although negotiations were entered into with the object of securing an alliance, it was not until Roebuck's failure in 1772 that Watt joined Boulton at Soho, he and his concern actually being taken over as a bad debt.

Engine Manufacture.

The combination thus effected was as unique as it was far-reaching in its consequences, Watt contributing superlative inventive genius and Boulton the practical administrative sagacity which was indispensable to successful production.

The first step prompted by Boulton was the securing of an Act of Parliament extending the patent rights of the engine for a period of twenty-four years. This done, the manufacture of engines at Soho was commenced in earnest. Boulton devoted his whole resources to the task and brought himself to the verge of bankruptcy.

But though Watt was often plunged into the depths of despondency, Boulton's confidence and determination never failed him, and he had passed his sixtieth year before he reaped the rich rewards of his sacrifice and devotion.

An unsought quarrel with John Wilkinson, the sour and disgruntled father of the iron trade, who had been entrusted with the all-important task of casting the nozzles for the engines, led Boulton and Watt to set up a foundry of their own, and to this circumstance the Smethwick Foundry, notable as "a nursery of men of invention and industry," was due.

Boulton added to his fame by his inauguration of the modern system of coining. It took him nearly ten years before he could induce the Government to give him the power of making a copper coin. He made coinages of copper for the East India Company; silver for the Sierra Leone Company; two complete coinages for the Russian Government; and in 1797 undertook the production of a new copper coinage for Great Britain. It was only as late as 1882 that a Boulton press at the Mint, Tower Hill, London, was finally discarded.

Darwin's Impressions.

Darwin, the scientist, a personal friend of Boulton, was immensely impressed by the sight of the coining mills at Soho. "The whole of this expensive and magnificent apparatus," he writes, "moves with such superior excellence and cheapness of workmanship, as well as works with such powerful machinery, as must totally prevent clandestine imitations, and in consequence saves many lives from the hands of the executioner, a circumstance worthy the attention of a great Minister. If a civil crown was given in Rome for preserving the life of one citizen, Mr. Boulton should be covered with a garland of oak."

In 1797 Boulton obtained a patent for a method of raising water by impulse.

It is a significant fact that out of the association of Boulton, Watt and Murdock grew the conception of modern industrial organisation. Boulton was really the father of the idea of organised production. Before his day the employment of such large bodies as nearly one thousand men in various operations in one factory was entirely unknown.

Boulton's fame in scientific circles was hardly less remarkable than his renown in industry. A Fellow of the Royal Society, and member of the Lunar Society, he was on terms of more or less intimate friendship with nearly all the chief scientific and literary men of his time. Franklin, Priestley, Darwin, Wedgwood, Edgeworth and others were frequently his guests at Soho, where both English and foreign notabilities fraternised.

Blow to the Community.

A man of genial and generous disposition, pacificatory in manner, and pleasing in conversation, yet keen and discerning in judgment, he was popular with all classes, and his death at Soho on August 18, 1809, was a great blow to the community. A remarkable tribute of public esteem was paid on the occasion of his funeral in the parish churchyard at Handsworth. Thousands of spectators lined the roads, and the funeral procession included upwards of five hundred employees of the firm.

A medallic token was presented to all who attended the funeral, recording the age of Boulton and the day of his death.

Considering what he did for Birmingham, it is a surprising thing that no public memorial of Boulton exists in the city. His name is simply perpetuated by an insignificant thoroughfare which is called after him.

Wear of Metals.—Several papers presented before the recent annual meeting of the American Society for Testing Materials, dealt with tests of metals or other materials, to determine their resistance to wear. Both steels and non-ferrous metals were included in the four papers. In the Paper presented by Mr. J. M. Blake (engineer of tests, American Manganese Steel Company, Chicago Heights, Ill.), an apparatus was described which has been developed to test the resistance of metals to abrasion under so-called wet-grinding conditions. The wear was measured by the amount of metal worn off in 15,000 ft. of travel at a speed of 125 ft. a min. The wear thus determined was expressed as the ratio of loss by wear compared with a standard (commercially pure) iron at 100. The abrasion factors for some of the materials tested were as follow:—Standard specimen (commercially pure iron), 100; merchant bar iron, annealed, 92; white iron, 88; manganese steel, 77; tool steel, hardened, 76; white iron, chilled, 72; high-speed metal, hardened, 57; stellite (welded wearing face), 51.

British Facilities for Foundry Education.—No. VI.

The Metallurgical Department Armstrong College, Newcastle-on-Tyne (University of Durham).

By P. A. Fox Allin, Associate Editor of The Foundry Trade Journal.

Until some five years ago the metallurgical laboratories at Armstrong College, came under the mining department, and they were in the main devoted to the work of assaying. When, however, Professor Louis retired in 1923 a separate department was created, and its conduct placed in the hands of Dr. J. A. Smythe, D.Sc. (Dunelm), Ph.D. (Göttingen), William Cochrane Lecturer in Metallurgy. For the time being there is little in the equipment of direct and general foundry interest. An excellent foundry, with modern plant, forms an auxiliary to the engineering department, but that for reasons previously stated is beyond the scope of our subject.

In the main laboratory there is a fine bank of six wind furnaces, two coke-fired muffle furnaces and fume chamber, the whole being connected to a common flue, which is provided with induced draft by a motor-driven fan. There are also three gas muffles. Parallel with the furnaces are a line of benches for the students, and at one end a collection of various ores, etc., so that the students can see what they are working on, whilst at the opposite end there is a bench set off for making castings in chills. The system provides for the student making, casting, testing and examining microscopically various non-ferrous alloys.

On the opposite side of the laboratory a table is set apart for (1) electric furnaces, including a small furnace for annealing and heat treatment in which temperatures up to 960 deg. C. can be maintained; (2) a muffle furnace for temperatures up to 1,300 deg., C., and (3) tube furnaces which, with other small electric furnaces, are made by the students as required.

There is an arc furnace for melting, this is cased in "Nonpareil" lagging, which, indeed, is used very generally in the laboratory, as it lends itself so readily for shaping. A small furnace heated by Bunsen burners which will bring down copper in 20 minutes completes this portion of the equipment. All the furnaces are, of course, controlled by pyrometers, and a Cambridge potentiometer also is installed. Other equipment includes galvanometer, balances, a small Brinell machine, small electrically-driven vacuum pump for the distillation of metals.

In a small room which goes off the laboratory are installed lathe, drill and various crushing units, there is also a small room for special research work which is equipped with a Watson microscope, and the apparatus necessary for the preparation of sections. There is also an excellent dark room. In connection with the main laboratory a museum is in course of formation.

The metallographic laboratory contains four microscope benches for students, provision for wet and dry polishing. The polishing tables were designed in the laboratory; they run on ball bearings, the polishing media being kept mixed in the form of a slurry which is at once cleanly and convenient. There are several small electric furnaces, a fume chamber, and assembled in cases a very comprehensive collection of ores and metals. A dark room is attached to this laboratory.

The testing laboratory is common to the engineering and metallurgical departments. The apparatus includes a Buckton 100-ton hydraulic machine, a Buckton tensile machine of 250 lbs., Izod and Brinell machines, and an Avery machine for fatigue testing.

Centenary of the Hot Blast.—On September 11, 1828, was filed an English patent granted to James Beaumont Neilson, a Scotsman, for his invention of the use of the hot blast in smelting iron and in commemoration of the centenary of the event, Mr. Thomas B. Mackenzie has written a short life of the inventor, which has been published by the West of Scotland Iron and Steel Institute. The annual dinner of the Institute next month will be devoted specially to honouring the memory of the inventor of the hot blast.

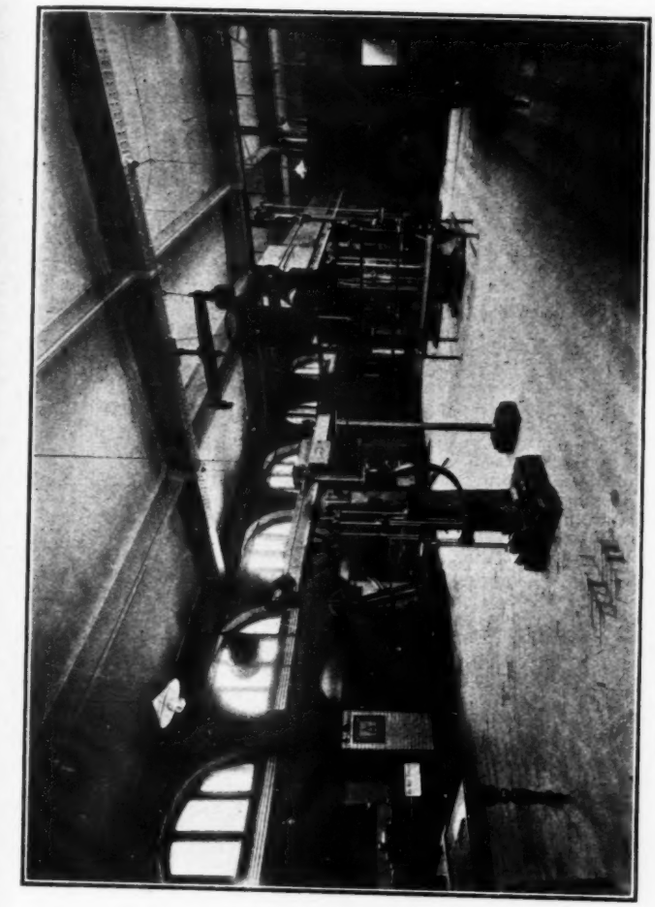


Fig. 2.—Mechanical Testing Laboratory, Armstrong College.

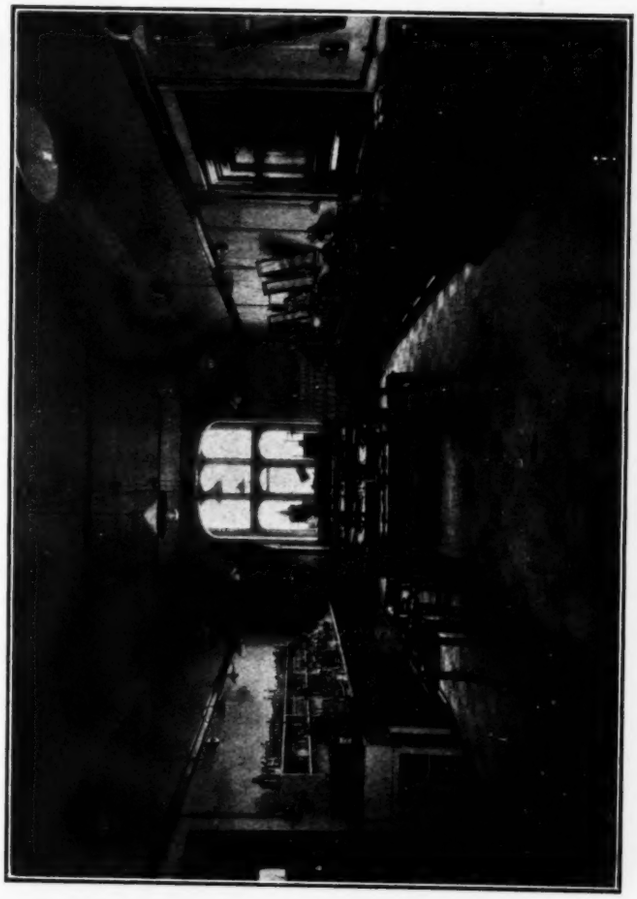


Fig. 4.—Metallographic Laboratory, Armstrong College.

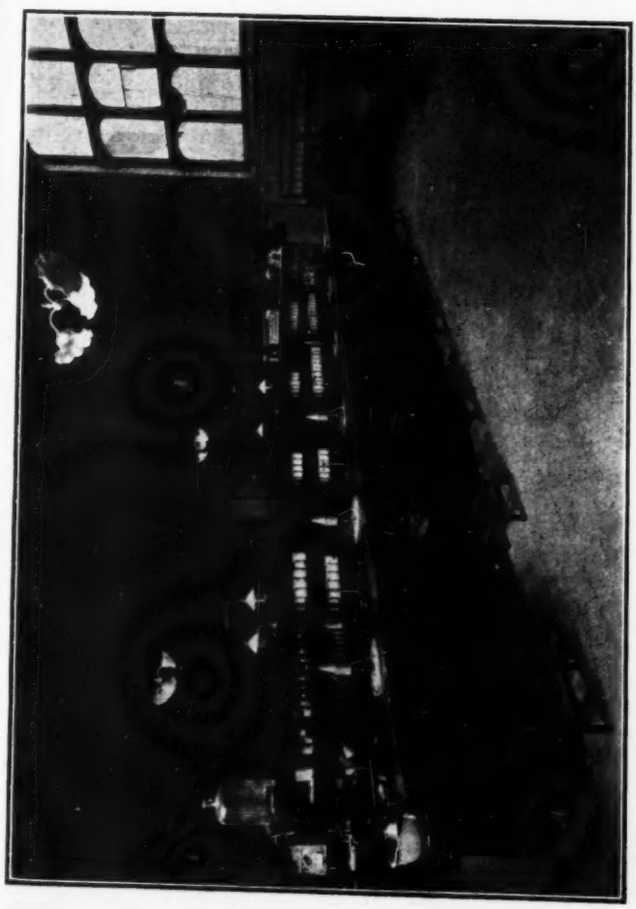


Fig. 1.—Student Benches in the Metallurgical Department of Armstrong College, University of Durham.

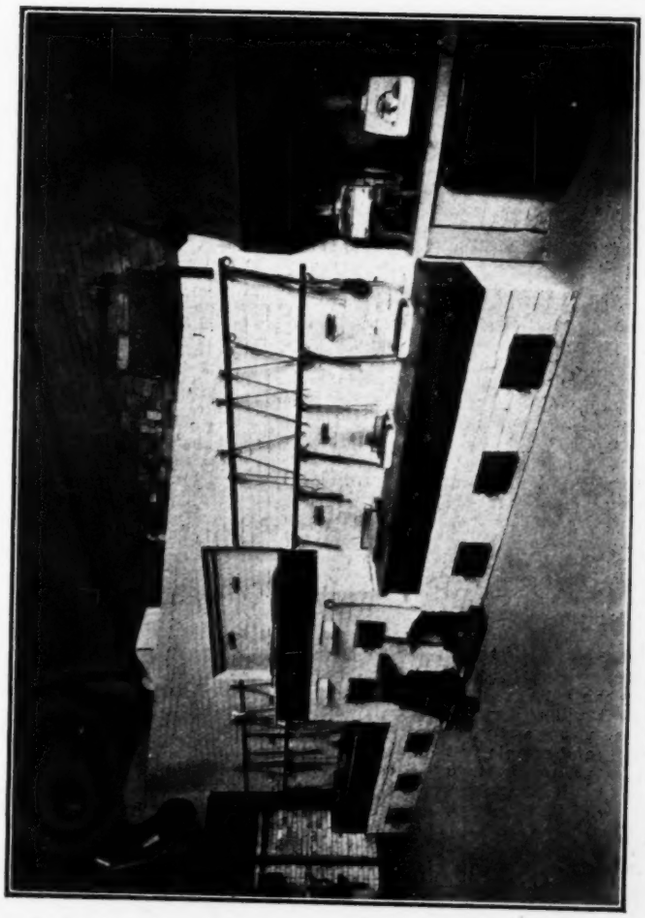


Fig. 3.—Bank of Melting Furnaces, Armstrong College.

Notes on Patternshop Management.—V.

By Ben Shaw.

THE TIMBER SHED.

The foreman patternmaker should give much consideration to the timber shed, and also the breaking out of timber. The most economical way is for one man to be made responsible for breaking out all the timber that will be used for both patterns and coreboxes. In this way small ends are used up. Timber is, of course, the most important patternmaking material, and yellow pine, for all but small work or medium-sized work, from which it is contemplated that a quantity of castings will be required, is almost universally used. It is a mellow, comparatively straight-grained wood, fairly free from knocks and shakes, and easily carved. It does not warp or absorb moisture to anything like the extent of the open-grained spruce, which should never be used for patternmaking. Spanish mahogany makes good small patterns, but it is seldom used, quite a good substitute being found in American baywood or Honduras mahogany.

Possible Substitutes.

Teak is used in some patternshops, and it has some outstanding qualities. It does not warp much, and the natural oil it contains assists in preventing the absorption of moisture; it is, therefore, not liable to shrink or swell, but, on the other hand, it is rather brittle, and edged tools require very frequent attention when working it. Cypress and red pine are used in small quantities, as also are sycamore, maple, plane tree, lime tree, and cherry. Sycamore, maple, or plane tree are tougher and more pliable than mahogany, and they are sometimes given preference for small or standard work on that account. Both lime and cherry are particularly useful when much carving is to be done, very fine edges standing considerable wear without damage. Though these woods are used to a limited extent, they invariably take more time to work than baywood. Lignum vitæ is not actually used for making patterns, but patternmakers often bush stern-tubes in marine shops, for which purpose this hard timber is always used because of its self-lubricating properties.

Spruce is used by some firms because it is cheap, but it is a very doubtful economy; not only is the resultant pattern unsatisfactory, but the labour charges are greatly increased, and this is so even when the spruce is well seasoned. Bass wood has also been tried, but without much success. Yellow pine is, all things considered, the best kind of timber for general patternmaking. Baywood or teak are the favourite timbers for small standard patterns, baywood especially, because, like yellow pine, it is easily worked and retains its shape. Most patternshops can do with different qualities of pine for high-class and cheap work, and it is for the foreman to see that the superior quality is not used for one-off jobs.

Laziness and Waste.

An experienced foreman patternmaker keeps a watchful eye on the machines because of the waste that is involved in careless marking-off of timber. Some men will reduce a full-length board half an inch in thickness by planing to save going to the timber shed for a thinner board. Shavings always represent waste, and it is not good for workmen, any more than employers, that more timber should be converted into shavings than is quite necessary. At the band-saw also much timber is sawn to waste; when cutting segments considerable economy can be effected by choosing a board of a width that will not waste a strip of timber, and sometimes using a slightly narrower one means a saving of several feet of timber. It is a fact that a big wastage is caused in many patternshops owing to unused timber not being returned; it is thrown on scrap heaps or left about in odd corners. An important argument for the requisition note when obtaining timber is that there is less scrapping of material because of knots or windshakes, which do not detract from the value of the timber for many purposes. It may not be possible for a foreman to know whether the timber being requisitioned is sufficient or too much, but it acts, nevertheless, as a check, and prevents several journeys to the timber shed.

When too much timber has been obtained, or when a job is cancelled, the unused timber should be returned and credited to the job. It may seem unnecessary to labour this point, but in many patternshops even yet there is no check on the timber. The men saw down as much timber as, after a rough calculation, they think they will require, and enter it in a small book or on a card. Sometimes as much timber is marked down as could have done the job two or three times over. In large shops it certainly pays to place a man in charge of the timber shed, and it is also advisable that requisition orders should be used, the foreman signing before timber is supplied.

Stocking Small Timber.

In some small shops there is room for timber racks inside the shop, and sometimes it is stocked in a special drying room. Perhaps the ideal method is to have a timber shed adjacent to the shop. This not only keeps the patternshop more tidy, but it obviates the possibility of constructional or machining work by men getting out timber. The best method of stacking it is that in which it will dry best, and this is undoubtedly in an upright position, suitably divided. A rack does not occupy more space than placing the boards on top of each other, and if the thicknesses are kept separate, stocktaking is simplified. It is advisable to have cross supports for the timber not more than 3 ft. apart in order that short lengths may be racked. If for any reason it is not possible to rack the timber, the boards should be kept apart with strips about 1 in. square in order that the air can pass freely between them. If the same thicknesses are kept together there should be no need for turning over the boards, as one important objection to this method of storing timber is that the different thicknesses frequently get mixed. Smaller patternshops, which have not a planing machine, sometimes obtain the timber from the mills, planed, a small extra charge being made per board, and when racks are used the surfaces are not spoiled through being trampled on.

Dry Wood Essential.

When there is a yard adjoining the patternshops it is good practice to stack it in an almost vertical position. The racking structure should be in the form of trestles. In this timber stack the rain drains off in wet weather. In the writer's opinion, it is much better to store timber for patterns in a shed, and there is thus a choice of two methods open: the boards may either be placed on top of each other, or they may be racked. Timber always contains a percentage of moisture, and even stove-dried timber when brought into the atmosphere absorbs moisture, but when it is saturated or unseasoned it is quite unsuitable for patternmaking. It is impossible to obtain good results with wet timber, and if it comes from the sawmill in this condition it should not be used until it has had time to dry.

It will be generally agreed that if economical production of patterns is aimed at the greatest consideration should be given to the economical use of timber, and to classifying the timber according to the quality of pattern for which it will be required. How to economise in timber is a question on which there is much difference of opinion. In some kinds of woodwork, such, for instance, as motor body building, it is possible to almost eliminate leakage, but a certain amount of waste is unavoidable in the patternshop, although the amount of the waste depends greatly on the shop organisation, the foreman, and the skill of the men—a skilful man will generally cut less to waste than a less skilful one. The former will invariably define an awkward shape on a board geometrically, thus saving time and timber, while the latter gets the timber larger than required, and fits to position. Thus skill in patternmaking does not mean merely a saving of labour, but frequently involves a considerable saving in timber. It is, therefore, advisable to keep a close check on the timber bill.

Small Stores.

Estimates of patternmaking work are not always formed with due regard to the various elements of costs that enter into construction, and when comparison cannot be made with similar work previously executed, it is frequently a matter of chance whether or not the estimate allows a fair return. It is then exceedingly important that timber economics should be effected, and stacking methods play an important part. Glue, shellac, paint, screws and nails are, from a cost point of view, of small account compared with timber.

When on the subject of timber storage it may be well to discuss briefly the storing of other materials, such as screws. In some small shops it is customary for the foreman to keep materials in a cupboard and supply them as required. In other cases the general works store stocks all the materials that the patternshop requires. In a few there is a special store room in the patternshop conducted on the same lines as the general works store, and materials are supplied by the storeman on presentation of an order form initialled by the foreman. This is the best method when it can be adopted, but it is only possible in the case of the largest shops. It may be admitted that leakages occur whichever storing methods are adopted, but on some work these items are an important factor from a cost point of view. Further, when no record is kept carelessness is encouraged, and material is wasted. Details of organisation such as these have an important bearing on the dicipline and efficiency of the shop.

(To be continued.)

Catalogues Received.

Induced Draught and Flue Dust Arresting.—This is the title of publication No. K 81 issued by James Keith & Blackman Company, Limited, of 27, Farringdon Avenue, London, E.C.4. It describes and illustrates in its 24 pages apparatus for ensuring adequate positive draught from chimney stacks and for minimising the escape of flue dust into the atmosphere.

Ball Bearings.—Messrs. Ransome and Marles Bearing Company, Limited, of Newark-on-Trent, have prepared a new edition of their abridged catalogue, which gives details of the more popular sizes and types of R. and M. bearings. Information is given for the mounting and maintenance of bearings in a particularly handy form. We understand that copies are available for our readers, and moreover an invitation is extended for founders to submit their problems in this department of engineering for gratuitous solution.

Refractory Cement.—The General Refractories Company, Limited, Wicker Arches, Sheffield, have sent us along an advance copy of a 24-page booklet containing a both interesting and rational account of the properties of Pyrolite. It is generally admitted that in furnace construction the brickwork joints are the weak point, and Pyrolite is a development designed to overcome this by providing a material which is claimed by the makers to be both highly refractory and mechanically exceptionally strong. The practical hints which are included make it well worth while writing to the company for a copy for filing.

Nearly four tons of explosives were used when a section of cliff was blasted at the Llysfaen limestone quarries of Imperial Chemical Industries, Limited, on Tuesday, 40,000 tons of limestone being stripped from a face about 100 ft. deep. Meteorologists, seismologists and other experts from Government departments and research laboratories were present, and the explosion was photographed with cinema cameras.

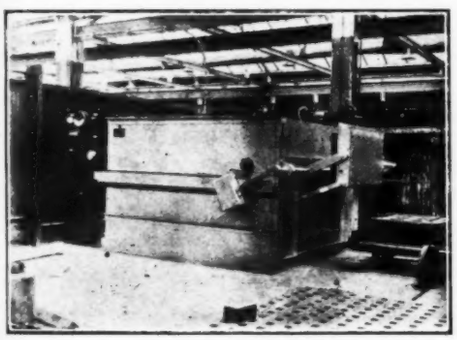
The Use of Nickel-Chromium Alloys in Electric Furnaces.*

By A. Glynne Lobley, M.Sc.

Early History.

It is generally well known that the electric resistance furnace is making very rapid strides in its application to industry, but rapid though this development is now, the advent of the electric resistance furnace on a large scale is comparatively recent—much more so than that of the arc furnace used in the steel industry or even than the earlier types of induction furnace. The reason is that these furnaces are dependent on nickel-chromium alloys for their heating elements, and their development has therefore followed that of these alloys.

The modern resistance furnace is a descendant of the small laboratory tube or muffle furnace. In the earliest days the heating elements of these furnaces consisted of platinum wire or ribbon wound on a refractory muffle, the whole being embedded in some heat insulator such as kieselguhr. Obviously, platinum was too expensive for use on anything larger than laboratory apparatus, and no other metal was satisfactory. Nickel, the only less costly metal which could withstand oxidation to a sufficient extent, soon became brittle at high temperatures. Eighteen or twenty years ago, however, the introduction of the nickel-chromium-iron alloys provided a substitute for platinum, since they suffered little from either oxidation or embrittlement up to about 1,000 deg. C.



Birmingham Electric Furnaces, Ltd.

110-KW. ELECTRIC FURNACE.

Used for heating steel plates, this furnace has reduced labour costs by an amount equal to the total cost of the current consumed.

It now became practicable to increase the size of the muffles, but very shortly another limit was reached. The small sized refractory muffle or tube could be made in one piece and with thin walls. As the size was increased so was the thickness, causing a larger fall of temperature through the walls, thus limiting both the permissible internal temperature and the rate of heating. Further, the externally wound element was only practicable with a single piece muffle. It became apparent that if the heating element could be mounted on the inside of the refractory there would be no limit to the size possible, whilst the direct radiation would enable high heating rates to be used with small temperature gradients. It was not until about the end of the War that means for doing this were actually developed. One or two large furnaces were built privately in England, but the first published account is of large pit type furnaces built for the heat-treatment of guns in the United States.

From that time the application of metallic resistor furnaces to industry has spread with increasing rapidity in America. In Europe, however, and especially in Great Britain, little progress was made until the last year or two, but now signs are not wanting that the advantages are at last being realised, and that the near future will see a very large increase in the number of furnaces in use.

* Published by courtesy of the Editor of the "Mond Nickel Bulletin."

Limiting Factors.

Improvements in the manufacture of the nickel-chromium alloys has resulted in a more consistent and reliable product, so that to-day the life of metallic resistors in a properly-designed electric furnace is very good. In practically all cases the 80/20 nickel-chromium alloy is now used instead of the older alloys containing iron, though other alloys containing more chromium and some iron are being developed. With the 80/20 alloy, known as "Brightray," "Chrome P.A.," "Nichrome IV," etc., furnace temperatures as high as 1,100 deg. C. have been recorded, but, for reliable service, temperatures much over 1,000 deg. C. are seldom attempted. Exact data regarding durability at these temperatures are not available, the life being dependent on so many factors other than the composition of the resistor, the failure of which is more likely to proceed from physical deformation than from oxidation. Although these alloys possess great strength at high temperatures—far greater indeed than that of any of the common metals—their strength at temperatures over 800 deg. C. falls much below that at ordinary temperatures. When subjected to mechanical stress at high temperatures the metal is very slowly deformed—the phenomenon known as "creep"—and great care has therefore to be taken in the design of electric-furnace heating elements and their supports to prevent this, or at least to reduce it to a negligible amount. One of the earliest and simplest types of resistor, still employed by many makers, is made with wire wound into the form of a spiral or helix, and supported on shelves or grooves in the refractory walls of the furnace. This method gives rise to but little mechanical deformation owing to the frequent intervals at which the element is supported, but has, however, the serious and inherent disadvantage that the side of the helix away from the furnace interior is masked by the wall on one side and by the other part of the resistor on the other. In consequence this masked part becomes hotter than the rest and still hotter than the furnace. If the furnace has to be operated at a high temperature it is essential to employ a low electrical loading on the resistor in order to prevent this part becoming dangerously hot and endangering the life of the resistor. Provided that proper attention is paid to the design and the loading the helical resistor can be successfully employed, but, as shown above, for high-temperature work one must then be satisfied with a low furnace rating.

Devices for Increasing Electrical Loading.

A method which is preferred by many of the most successful makers is to use heavy section rod or strip bent into a sinuous form and mounted on the sides of furnace. The difficulties of mounting this type are greater, but owing to the greater freedom of radiation higher furnace ratings may be employed, with consequent increased furnace output. Some degree of masking may still occur at the points where the element is supported by the refractory, but in some cases this is reduced to a small amount by shaping the refractory so that only line contact is made, while in at least one case a patented method is used in which the resistor is supported by nickel-chromium hooks and does not itself touch the refractory. With such methods the electrical loading of the resistor may be very greatly increased, and as the resistor may be mounted on all sides of the furnace rapid yet even heating may be obtained.

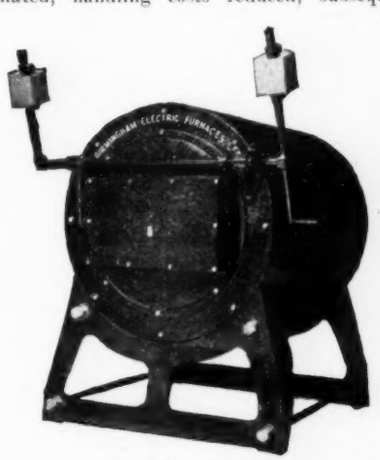
The metallic resistor furnace is being applied to a great many industries, new applications arising almost daily. At present its largest field is in the heat-treatment of metals, but it is finding increased use in other processes such as vitreous enamelling, firing of pottery colours, and the annealing of glass.

It has been very generally thought, and the idea is not yet quite extinct, that the power-cost of running an electric furnace is necessarily very much higher than that of any type of fuel furnace. Actually, with a properly-designed electric furnace, such is not by any means the case; even if it were, certain other factors must be given consideration in a comparison of the total costs of heating by different methods. A review of the claims made on behalf of the electric furnace may therefore be of interest.

Advantages Cited.

The basic advantages of the electric furnace are exactness of control and flexibility, and these two make it possible to design a furnace to fit almost any desired process. The main subsidiary advantages which can result, then, are:—(1) Uniformity of temperature; (2) automatic maintenance of constant temperature; (3) controllable rate of heating; (4) controllable furnace atmosphere; (5) elimination of the human factor; (6) reduced labour cost; and (7) adaptability to special loading and unloading methods.

In actual practice these points mean that a uniformly high product is obtained with rejects eliminated, handling costs reduced, subsequent processes often cheapened or even eliminated, and floor space saved, whilst the cleanliness and comfort of the working conditions greatly tends to an increase in general efficiency.



Birmingham Electric Furnaces, Ltd.

27-KW. STANDARD PORTABLE FURNACE.

Interior of furnace, door and door surrounds lined with sheet nickel-chromium.

The ordinary horizontal box type of furnace is probably the commonest, but this is often elaborated by the provision of special charging devices. Thus, there are furnaces with slotted hearths to take the arms of a charging machine; car type furnaces, in which the whole hearth is removed with the charge; conveyor, pusher and live-roller hearth furnaces, in which the charge is passed continuously through the furnace by a conveyor, by being pushed from one end, or by travelling on rotating rollers respectively. It is worthy of note that many of these methods, and especially the live-roller methods, have only been made possible by the advent of the heat-resisting nickel-chromium alloys. Another interesting type is the rotating annular hearth furnace, known in America as the "doughnut" furnace. In this the charge is put in at one door and travels round the furnace, being removed from a discharge door adjacent to the charging one. With this method the charge is subjected to a definite treatment as regards both temperature and time, and it is especially suitable for the heating of steel parts, such as gears, for hardening by quenching. It is usual, in fact almost essential, in such furnaces, to control in a number of zones. By setting the temperature of the first zone above the required

temperature for the material it is possible to accelerate the rate of heating without any fear of overheating, owing to the last or soaking zone being maintained at the exact temperature required for the charge.

Very considerable economies in the consumption of electrical energy may be effected by the use of counter-flow methods in those cases (*e.g.*, annealing) where the charge may be allowed to cool slowly. The general principle of this is that the heat from the outgoing and cooling charge should be used to preheat the ingoing charge. This may be done by arranging for the material to flow through the furnace in two streams in opposite directions. Where it is not convenient to do this, a reduced heat interchange may be obtained by placing the hot outgoing charge in an insulated chamber with a cold ingoing charge. Obviously with this modification the charge could not be preheated to more than 50 per cent. of the final temperature; in practice about 30 per cent. of the heat is recovered.

No mention has so far been made of the question of heat insulation. Modern insulating materials, having kieselguhr as their base, have made it possible to reduce heat losses through furnace walls to a minimum. In no type is this more important than the electric furnace, which, having no flue, loses heat through the walls only. Moreover, efficient insulation is easier with an electric furnace than with any other type, and when this is properly done the outside of the furnace will be little above room temperature. The most efficient recuperative type of gas furnace has a maximum thermal efficiency when new of 40 per cent., and most fuel furnaces far less; on the other hand, that of the electric furnace is commonly 80 per cent., and may reach 90 per cent., and moreover does not fall off with use as that of the fuel furnace almost invariably does. In this way the higher cost of electrical energy per "therm" is counterbalanced.

In this brief article it is, of course, possible to give only an outline of the subject, but it is hoped that it will serve the purpose of awakening further interest. One word of warning is perhaps necessary; the very simplicity in principle of the electric resistance furnace often tempts people to construct their furnaces, and in many cases good results have been obtained, especially at the lower temperatures. At the same time, to get the full benefit of the advantages of the electric furnace it is advisable to go to a maker who has made a special and successful study of the subject. Only in this way may one expect to obtain really even heating, long resistor life and a high thermal efficiency.

Publications Received.

The New Light, Vol. I. No. 1.—This represents one of the latest phases of advertising. The whole of the contents are designed to interest people in Pearl Osram Lamps, made by the General Electric Company.

British Engine Boiler and Electrical Insurance Company, Limited, Technical Report for 1927. Price 7s. 6d.

In view of Mr. John Shaw's recent remarks about this particular publication, we naturally evinced greater interest in its receipt than in previous years. From the founder's point of view this edition still maintains the desert mirage aspect so far as his products are concerned. It confirms that core shifts cause failures, and that cast iron will not withstand excessive water hammer. But we failed to find any helpful advice or details of researches which would enlighten the founder. Yet for the steel manufacturer there is a wealth of micros., sulphur prints and research data.

We insist that as machinery is largely an aggregation of castings, reinforced by forgings for dynamically-stressed parts, the 5,000 British foundries contributing to the make-up of British machinery are worthy of larger attention by the compilers of this book—a book which merits the sincere appreciation of every steel metallurgist.

New International Association for Testing Materials.

The following is the text of a statement issued by Sir Henry Fowler, K.B.E., regarding the formation of a British Committee (of which he is Chairman) in connection with the New International Association for Testing Materials:—

At a Congress held in Amsterdam in 1927, the New International Association for Testing Materials was formed. An International Association for Testing Materials of Construction was in active existence before 1914 and held a series of Congresses, the last in New York in 1912. The existence of this earlier Association was brought to an end by the war, and for many reasons British opinion was averse to the revival of the old Association. The activities of the British representatives at Amsterdam resulted in the adoption of a new and much simpler and more satisfactory organisation for the New Association. In particular, the whole question of International Standard Specifications has been entirely eliminated from the activities of the New Association.

In most countries there are National Associations for Testing Materials, but it has not been thought desirable to add to the large number of existing Societies and Institutions in this country by the formation of a British Society for Testing Materials. In order to secure adequate British representation in the New International Testing Association, however, and to secure satisfactory British support for an international movement of such importance, a British Committee has been formed. This consists of representatives appointed by a number of the most important British Institutions and Societies interested in materials of all kinds. A list of the bodies already represented on the British Committee is appended, together with the names of their representatives. A number of other bodies have, in addition, been invited to nominate representatives.

The British Committee have appointed Dr. W. Rosenhain, F.R.S., to act as British representative on the Permanent Committee of the New International Association, of which body he has since been elected a Vice-President. The Permanent Committee has likewise established four International Committees to deal respectively with each of the four Sections into which the work of the Congress is to be divided, and has appointed the following to be the Chairmen:—

Dr. W. Rosenhain, F.R.S. (Great Britain), Chairman of Committee for Section A—Metals.

Professor Ros (Zurich), Chairman of Committee for Section B—Inorganic non-metallic materials (cement, concrete, etc.).

Mr. Roos af Hjelmsater (Sweden), Chairman of Committee for Section C—Organic materials (oil, indiarubber, etc.).

Herr von Moellendorf (Germany), Chairman of Committee for Section D—Methods of testing.

The British Committee are anxious that British status and prestige in the International Association should be fully maintained, not only on the Permanent Committee, but also in the general work of the Association, and at the next International Congress which is to be held in Zurich in 1931. Adequate British representation at these Congresses, not only by the presence of a sufficient number of British members but by the presentation of Papers and reports and participation in discussions, is very important. In the interest of the Science and Art of Testing in this country, and the progress of materials generally, it is most desirable that British Technologists—and especially engineers and chemists—should avail themselves fully of the international interchange of experience and ideas which takes place, formally and informally, at the International Congresses. It is also important that British status should be properly maintained at such Congresses, as this has an important reflex effect on British trade abroad.

For these reasons, the British Committee of the New International Association for Testing Materials appeal to the members of the constituent Societies and Institutions to become members of the N.I.A.T.M. In order to make a widespread membership possible, the subscription has been kept at the nominal sum of 10s. per annum for individual members, and not less than double per annum for societies, firms, and undertakings in their corporate capacity. No entrance fee or formalities are required. All that is necessary is to fill in the membership form and to send it to the Hon. Treasurer at the address given below, with a remittance of 10s. in respect of individual membership, and 20s. or any higher sum in respect of corporate membership.

While membership and subscriptions are invited primarily for the purpose of supporting the important work of the New International Association for Testing Materials, and especially for maintaining adequate British participation, members will receive a periodical bulletin keeping them informed of the activities of the Association. In connection with the Congresses, which are to be held every three or four years, members of several years' standing will be entitled to certain privileges in regard to Congress fees and the purchase of Congress Proceedings at reduced prices. It is also hoped to organise arrangements for the visit of British members to the Zurich Congress in 1931.

The British Committee hope that a large number of members of the constituent Societies and Institutions will become members of the New International Association for Testing Materials at an early date.

Membership application and remittances should be sent to:—G. C. Lloyd, Esq., Hon. Secretary and Treasurer, 28, Victoria Street, London, S.W.1., from whom further particulars can be obtained.

The following are Institutions represented on the British Committee:—

Department of Scientific and Industrial Research (Sir T. E. Stanton, C.B.E., F.R.S.).

Institution of Civil Engineers (Professor W. E. Dalby, F.R.S.).

Institution of Mechanical Engineers (Sir Henry Fowler, K.B.E.).

Institution of Automobile Engineers (Sir Henry Fowler, K.B.E.).

Iron and Steel Institute (Mr. G. C. Lloyd).

Institute of Metals (Dr. W. Rosenhain, F.R.S.).

Institution of Petroleum Technologists (Dr. A. E. Dunstan and Mr. G. Sell).

Chemical Society (Dr. J. J. Fox).

Society of Chemical Industry (Mr. F. Heron Rogers).

Institution of Structural Engineers (Mr. R. H. H. Stanger).

Institution of Engineering Inspection (Dr. G. H. Gulliver).

British Non-Ferrous Metals Research Association (Mr. F. Tomlinson).

British Cast-Iron Research Association (Mr. J. G. Pearce).

British Engineering Standard Association (Mr. C. Le Maistre, C.B.E.).

Institute of Marine Engineers (Mr. A. T. Quelch).

The Manchester Association of Steam Users (Dr. Telford Petrie).

Nickel-Steel Castings in America.—A review of the progress in the production of steel castings in the United States during 1927 emphasises the increasing realisation of the value of heat-treated alloy-steel castings for a variety of purposes. A wide range of mechanical properties may be obtained by the suitable adjustment of the alloy elements, nickel, manganese, vanadium and chromium. High-manganese steel castings have a useful field of application where high resistance to abrasion and great toughness are required, but it has the disadvantage that it tends to flow under continuous heavy pressure. For parts working under conditions which involve heavy steam or liquid pressures some of the low nickel-manganese steels are found to be eminently satisfactory, and they are also easier and cheaper to manufacture than the high-manganese steels. Low-alloy steel castings of this type are also being used in a number of cases to replace forgings of intricate design. The remarkable resistance to heat and corrosion shown by the high-alloy nickel-chromium steel castings is leading to a rapidly increasing demand for this type of material for use under extreme conditions.

The Rumbling of Castings.

By H. C. James Carrington, M.I.Mech.E., A.M.I.E.E.*

The cleaning of castings and similar articles by rumbling or tumbling has long been carried on in a comparatively primitive way, and without very much consideration for either the comfort of the workpeople, who have by long use come to regard a dusty atmosphere as inseparable from this operation; or the improvement of the plant commonly used for the purpose, the very simplicity of which appeared to preclude the possibility of much improvement.

There is, however, on the part of the more progressive employers of labour, a very definite endeavour to improve the conditions under which the workers labour and live, for it has been proved that a healthy atmosphere tends to a contented mind and better work.

The proper ventilation of existing rumbling plant of the usual type, however, is difficult to apply—rarely very effective, is obtrusive, obstructive, and heavy in cost, while showing no adequate return for the capital outlay involved.

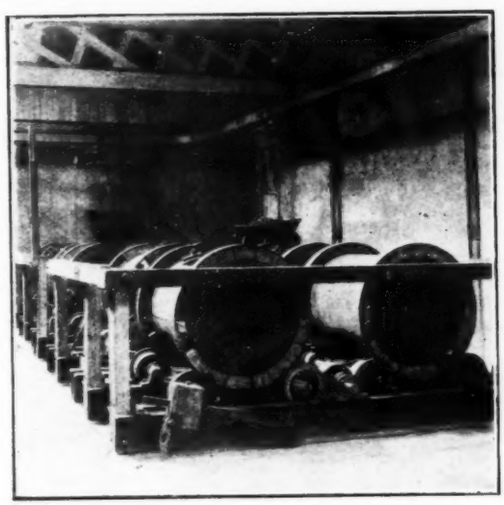


FIG. 1.—A GROUP OF TWELVE BARRELS. NOTE THE OVERHEAD FILLING TRUCKS.

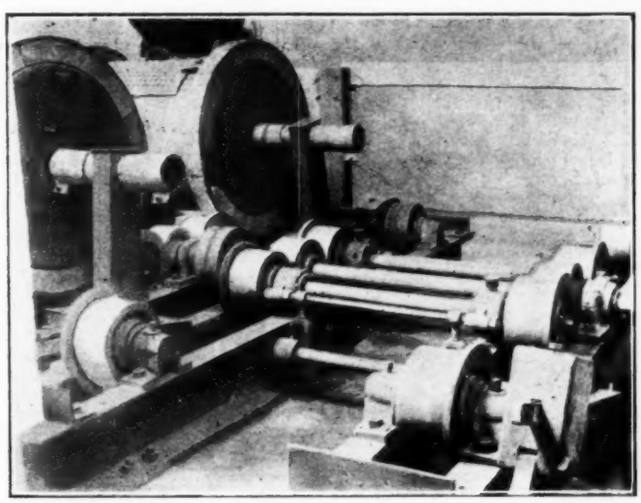


FIG 2.—HERE TWO BARRELS HAVE BEEN DISMANTLED TO SHOW THE VENTILATING DUCTS, ETC.

The pressure brought to bear by H.M. Inspector of Factories for such plant to be efficiently ventilated has, however, at last resulted in a full investigation of the abilities and possibilities of rumbling plant by the author who for many years has specialised on industrial works design and equipment. The result is a complete transformation of the humble rumbler into a high-grade and efficient machine or plant.

The word "plant" is used advisedly, for a single rumbler offers very little scope for the designer, but given a group of, say, twelve or more barrels, the problem is quite different, and offers scope for ingenuity and skilful design embodying as one complete machine or plant, the barrels, the driving gear, the ventilation and the handling of the material to and from the barrels. It is when so treated that the capital cost can be kept down to figures that compare favourably with the old type plant even when providing a high-grade machine fitted with dust-proof ball bearings, etc., that will class as high-grade engineering.

Such is the evolution of rumbling plant which we are now in a position to describe.

The illustrations are of a plant of twelve barrels recently installed, which embodies many of the latest features: the method of mounting the barrels is, however, not in accord with latest and best design, the keynote of which is robust construction, smooth running which makes for long life under the rough character of the work to be done, together with ease of manipulation from the labour-saving point of view and small power consumption.

The barrels are arranged as shown in Fig. 1 in a double row, with the drive shaft upon which the driving boles are keyed low down centrally between, and from which all barrels are driven by Carrington patent friction gear, the friction loads being thereby balanced and largely eliminated. The whole is mounted upon a self-contained foundation of rolled steel channels and girders as a single unit.

The ventilating system is novel and inconspicuous; and the arrangement gives a very pleasing absence of ventilating trunks, etc., so usually rather obtrusive. At first sight one wonders if ventilation is actually fitted, as is shown by a glance at Fig. 1. A reference to Fig. 2 will, however, show that a single hole is provided in the centre of one end of each barrel, and the barrels are arranged so that two outlet ends come together with a single "T" stand pipe between going into the floor. The ventilating ducts are underground earthenware pipes discharging into a water bosh also in the ground; from which the air is drawn by a suction fan and directed by baffle over a large surface of water which collects the dust and discharges the air outside the building. The whole plant is electrically-driven by motor fixed behind the back end screen.

The barrels themselves are plain welded steel cylinders, carried in a pair of independent cast-iron mounts with distance stays preserving alignment. The illustrations show a clipband mount now superseded. The Carrington patent improved driving mount is turned up in the lathe and always runs true even if the barrel itself is not true. The usual bellying of the barrel due to wear does not affect the truth of the running mounts; and when a barrel is worn out it can be easily taken out from the running mount and a new barrel inserted and put back to work inside an hour by unskilled labour.

The engaging of the friction-driven barrel is by means of the operating lever shown in the foreground of Fig. 1. On the lever being lifted the small prop attached to the lever weight falls into the vertical position by its own weight, and holds the lever propped up, the friction gear out of action, and the barrel stationary for loading or unloading. In this position the barrel can be turned freely by hand on the rollers indicated. For loading, the barrel is turned with the door upwards and work tipped in direct from carrying skep, whilst for unloading the skep is lowered on to the floor and pushed in between the front bearing channels and rollers, which are kept clear for that purpose and the barrel revolved by hand until the opening comes to the bottom to discharge into the skep.

To start the barrel to work all that is necessary is to lift slightly the weighted lever, kick forward the prop, and drop the lever which puts the friction gear into contact.

The overhead runway and the special carrying skeps referred to are clearly shown in Fig. 1. The runway along each side of barrels provides a very easy means of lifting and carrying the barrels by using the two runways, one each end of a plank over which is a common dog sling on the barrel. Fig. 2 is a close up view, reproduced especially to show the simplicity of the ventilating of the barrels. For the purposes of the photograph, two barrels have been lifted off the friction rollers so that the "T" ventilating stand pipes can be clearly seen. A small clip length adjustment on the "T" arm being provided to give as near as possible contact with the barrel without actually touching, by which arrangement the barrels rest upon the rollers without connection to anything, and are therefore free to be lifted off at will without disturbing anything, and here the stream-line effect of the dust-laden moving air can clearly be seen through the small gap between the barrel and the end of the "T" pipe; the dust-laden air being drawn across from the barrel forming a practically full pipe bore showing very small leakage at this gap, notwithstanding the absence of actual joint.

In this illustration the farthermost barrel is shown with a perforated door for air inlet to the barrel, but it was found that although the holes were only ¼-in. diameter on the inside but countersunk outside, this permitted the dust to fall out and it is found that the air leakage round the average solid door is sufficient air inlet to the barrel for good ventilation, and this amount of air inlet keeps the atmosphere free of dust, whereas the door perforated with the small holes provided a dusty atmosphere, although infinitely better than was the case without ventilation fitted to the barrels.

A special feature of the Carrington patent friction gear is that there is *no* movement of the barrel position from the on to the off position. It is therefore applicable to calanders drums or other cases where a definitely fixed centre is required in first-class machine-tool practice. For this reason, therefore, this gear should find wide application.

* The author is a consulting and constructional engineer, located at Winchester House, Victoria Street, Birmingham.

Notes on the Routine Analysis of Cast Irons and Iron Foundry Raw Materials—No. 5.

(*Continued from page* 188.)

By Arthur Smith, M.A.

Estimation of Manganese (*continued*).

The Application of Electrometric Titration Methods to the Estimation of Manganese.—Along with chromium and vanadium, the estimation of manganese in steels and ferrous alloys such as cast irons lends itself to electrometric titration methods, and Dr. G. L. Kelley, of U.S.A., has perfected apparatus for the very accurate estimation of these elements by this means. Very great accuracy can be achieved by methods of this type, in which the end-points of quantitative oxidation and reduction reactions are indicated by the change in the oxidation potential. One great advantage of this method is that the end-point is independent of colour, and turbid solutions, or solutions containing suspended matter, give sharp end-points, no chemical indicators being necessary. As far as manganese is concerned, the usual persulphate and bismuthate oxidation is used, and the oxidised manganese is electrometrically titrated with standard mercurous nitrate solution, and back titrated (electrometrically) with standard permanganate solution. The change of oxidation potential is measured by means of a sensitive galvanometer, which indicates difference of E.M.F. Platinum and calomel electrodes, when immersed in an oxidising solution such as permanganic acid or chromic acid, form a cell with a definite E.M.F. The addition of a reducing agent, such as mercurous nitrate, or ferrous sulphate, causes a slight change in potential, but this remains infinitesimally small until an excess of the reducing agent remains in the solution. The presence of a minute excess of the reducing agent, however, brings an immediate and very large drop in potential. The adoption of this method for manganese as well as chromium and vanadium is likely to be widespread in the larger metallurgical laboratories when the value of this apparatus becomes known. The method is accurate and extremely rapid, and the presence of chromium does not interfere in any way with the manganese estimation.

Estimation of Phosphorus in Cast Irons.

Iron forms numerous binary compounds with phosphorus of the class known as phosphides. It has been shown by various research workers that pure iron is capable of retaining about 1.7 per cent. phosphorus in solid solution as the phosphide Fe_3P. Stead, in his classic research, showed that this solid solution was definitely the phosphide Fe_3P and not the element phosphorus. He also showed that the addition of about 10.2 per cent. of phosphorus resulted in the formation of a true eutectic of iron and the phosphide, this eutectic constituent having the comparatively low melting point of 980 deg. C. Obviously with high-carbon iron-alloys such as grey cast irons the amount of this phosphorus-iron-eutectic present in any such alloy has a profound influence on the set point of the material. Dr. Stead proved very conclusively that with each increase of carbon to iron containing approximately 1.7 per cent. phosphorus an increasing amount of that phosphorus was thrown out in the form of free phosphide, and also that in the cast-iron range of iron-carbon alloys there was definite evidence of the presence of a carbon phosphide eutectic, so that in the so-called foundry irons the phosphorus content exerts a powerful influence in determining the melting point of such material. The highly phosphoric irons consequently can be melted at a much lower temperature than hematite irons containing little phosphorus. Yet the highly phosphoric irons are ideally suited for the production of small, light and intricate castings, where the comparative brittleness, due to the high phosphorus content, is no great disadvantage. From the above remarks it will be seen that the metallurgist's task in estimating the phosphorus content of the so-called foundry or phosphoric irons is quite a different one from estimating the same element in low-phosphorus material such as hematites, high steel mix, and low-phosphorus refined irons. The limits of accuracy necessary for the first class can be very much wider than those required for the second. Especially is this the case in estimating the phosphorus content in hematite irons to be used for steel making, where a difference of 0.01 per cent. in a total phosphorus content of perhaps 0.05 per cent. may make a very great difference indeed to the value and utility of the material being analysed.

The choice of methods available to the chemist for the estimation of phosphorus is a very wide one. His ultimate aim is to eliminate the phosphorus in the form of some readily handled and stable phosphorus compound of constant composition. The two most common of such compounds are probably magnesium pyro-phosphate and ammonium phospho-molybdate. In the analysis of cast iron it is usual to make use of the latter phosphoric compound which, when pure and when dried at 120 deg. C., has a definite composition $(NH_4)_3PO_4\,12MoO_3$, which in practice is found to consistently contain 1.63 per cent. of the element phosphorus, although it requires 1.65 per cent. to satisfy the formula. The complete precipitation of this well-known "yellow" precipitate must be carried out under very definite and explicit conditions, details of which will be given later, and it must also be washed and dried very carefully if accurate results are to be achieved. Other alternatives to drying at 120 deg. C. are (1) the ignition of the yellow precipitate to $P_2O_5\,12MoO_3$ at a temperature of 450 deg. C. for a definite and predetermined period, or (2) the phosphorus in the yellow precipitate, which is really an acid anhydride, may be titrated against standard alkali; (3) the yellow precipitate may be converted into the equivalent amount of lead molybdate and weighed as such. For any chemist who prefers a gravimetric finish, this is an excellent one, as filtration and ignition may be carried out without any special precautions, the compound being very stable. (4) Another alternative finish is to dissolve the yellow precipitate in ammonia and reprecipitate the phosphorus as magnesium ammonium phosphate, and subsequently igniting to MgP_2O_7. There are certain elements which are nearly always present in grey cast irons, varying in amount from the minutest traces up to considerable quantities, which directly interfere with the estimation of phosphorus by means of molybdic acid or ammonium molybdate, rendering the resultant ammonium phospho-molybdate impure. The chief of these elements are arsenic and titanium. Consequently standard methods have to be considerably altered where the amounts of either or both of those elements are considerable, or where the amount of phosphorus present is so small that the inclusion of more than the minutest traces of either arsenic or titanium will vitiate the usefulness of the resultant analytical figures.

The Standard Method.

First let us consider a standard method, suitable for the phosphoric irons, where it is not proposed to isolate arsenic and titanium. For this class of routine work the author strongly favours the wet oxidation straight molybdate method, coupled with a volumetric or lead molybdate finish. The principle of the method is briefly as follows:—The sample is obtained in the form of a nitric acid solution free from graphite. Combined carbon is destroyed by means of oxidation with potassium permanganate solution. Excess permanganate is destroyed with ferrous sulphate. The phosphorus is then precipitated by precipitation with ammonium molybdate solution in the presence of considerable excess of ammonium nitrate. The resultant yellow precipitate is then dissolved in a standard solution of sodium hydroxide, the excess alkali being back titrated with standard nitric acid. The chief reactions involved may be represented by the following equations:—

$$H_3PO_4+12(NH_4)_2MoO_4+21HNO_3 = (NH_4)_3PO_4\,12MoO_3+21NH_4NO_3+12H_2O. \quad (i)$$

$$(NH_4)_3PO_4\,12MoO_3+23NaOH = 11Na_2MoO_4+(NH_4)_2MoO_4+Na(NH_4)HPO_4+11H_2O. \quad (ii)$$

From the second equation it will be seen that one molecule of yellow precipitate requires 23 molecules of NaOH for its neutralisation. The standard NaOH is best standardised against pure yellow precipitate, which can either be prepared from a pure sample of disodium hydrogen phosphate Na_2HPO_4, or it may be bought in pure and reliable form from such well-known suppliers of fine chemicals as Merck, of Darmstadt.

Details of Routine Method.

The reagents required are prepared as follows:—

Ammonium Molybdate Solution. — Dissolve 100 gms. crystalline ammonium molybdate in 1,000 ccs. distilled water. In the author's opinion it is much better to use this simple solution in the standard method, which is to be described, than to use either a solution of molybdic acid or an ammoniacal and acid solution of ammonium molybdate. Provided other details are rigidly adhered to, the straight neutral solution will be found to give excellent results.

Potassium Permanganate Solution. — Dissolve 50 gms. of the salt, $K_2Mn_2O_8$, in 1,000 ccs. of distilled water.

Ammonium Nitrate.—It is most convenient to add the crystalline salt as required.

Ammonium Nitrate Wash.—Dissolve 5 gms. in 1,000 ccs. of distilled water.

Ferrous Sulphate.—Dissolve 250 gms. of phosphorus-free ferrous sulphate in distilled water, add 20 ccs. conc. H_2SO_4, and dilute to 1,000 ccs.

Sodium Hydroxide.—Make the strength of the solution such that 1 cc. equals 0.0002 gms. phosphorus. This may be made by dissolving 15.4 gms. pure NaOH in approximately 300 ccs. of water. Free from Na_2CO_3 by precipitation with a saturated solution of barium hydroxide. Filter off the $BaCO_3$ and dilute the filtrate to 2,000 ccs. Standardise against yellow precipitate and adjust by dilution to give required factor.

Nitric Acid.—Dilute 20 ccs. of concentrated HNO_3 to 2,000 ccs.

To Standardise the Acid and Alkali.—Weigh out 0.2452 gms. of dry yellow precipitate, add 100 ccs. distilled water and 20 ccs. of the NaOH solution, which will dissolve the yellow precipitate to a perfectly clear solution. Add a few drops of phenolphthalein solution and titrate with the standard HNO_3 till colourless. The difference is the number of cubic centimetres of HNO_3 equivalent to 0.2452 gms. of yellow precipitate containing 0.004 gms. of phosphorus. Dilute the HNO_3 to make 20 ccs. exactly equivalent to 0.004 gms. of phosphorus. After checking this result by repeat titrations, dilute the NaOH solution, so that 20 ccs. is exactly equal to 20 ccs. of acid and consequently equal to 0.004 gms. phosphorus, *i.e.*, 1 cc. of NaOH is equivalent to 0.0002 gms. phosphorus. As an extra check it is advisable to titrate the nitric acid occasionally against pure sodium carbonate. The acid, if carefully stored, will remain constant for many months, but the NaOH should be checked against it daily.

(*To be continued.*)

Inadequate Dust-Extraction Plant.

Two Coventry foundries have been fined for failing to provide adequate appliances for the interception and removal of dust from their fettling shops. One concern was also fined for failing to keep a register containing particulars of the examinations and tests of the ventilating plant at the works.

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Trade Talk.

STERLING FOUNDRY SPECIALITIES, LIMITED, London Road, Bedford, have commenced the manufacture of a wide range of steel tubular general-purpose foundry wheelbarrows.

THE SHOTTS IRON COMPANY, LIMITED, have shut down the two blast furnaces which had continued working, and all five furnaces at Shotts are now idle. The by-products plant has also been stopped.

BURTON-ON-TRENT CORPORATION ELECTRICITY COMMITTEE have accepted the tender of Messrs. Johnson & Phillips, Limited, for the supply of the switchgear in connection with the furnishing of electricity to Granville Colliery.

MESSRS. RD. JOHNSON, CLAPHAM & MORRIS, LIMITED, of Jacem House, Trafford Park, Manchester, are issuing a handy screw, nail and wire gauge. It has a 3-in. rule on one side, divided into 1/8, 1/10 and 1/12 in., and is punched for attachment to a key-strap or chain.

MESSRS. HENRY ROBB, LIMITED, Leith, have obtained orders for a light-draught twin-screw motor vessel of the shade-deck type for passenger, cargo and cattle-carrying service on a South American river, and also for two motor-propelled vessels fitted with pumping plant for irrigation work in the Far East.

THE NEW boiler and locomotive shops in course of construction at the Scotswood Works on Tyneside of Messrs. Sir W. G. Armstrong, Whitworth & Company, Limited, are now more than half completed. They are expected to provide work for 4,000 additional men during the next two or three years.

IT IS EXPECTED that the Canadian Pacific liner "Empress of Canada" will be taken off the Pacific service in November and sent to Govan, where new engines will be installed by the Fairfield Shipbuilding and Engineering Company, Limited. The existing boilers are to be fitted with superheaters, and the present double-reduction gearing with Brown-Curtis turbines replaced by single-reduction gearing driven by higher-powered turbines of the Parsons' type, which will result in the attainment of greater speed. Work on the new engines has already been commenced.

AT AN extraordinary general meeting of the General Electric Company, Limited, held in London, resolutions were unanimously passed altering the articles of association to prevent the corporation coming under foreign control. Mr. Ernest C. Byng (vice-chairman), who presided in the absence abroad of Sir Hugo Hirst, referred to the remarks of the chairman at the recent annual meeting, and added that since then the number of shares held by banks in favour of shareholders not disclosed had considerably increased. They felt their proposals were necessary in the national interests as well as those of their great company. Proxies had been received representing 2,085,000 in favour of the proposal, and no proxies against it, and 10,000 shareholders had sent in proxies out of a total of 15,000. The resolutions were unanimously adopted.

THE FIRST of the great schemes for unification and co-ordination of electric power on a national basis is at present being carried out, and the many months of preliminary investigation on the part of the Electricity Commissioners and the Central Electricity Board are bearing fruit. The Central Scotland Electricity Scheme aims at linking up the main generating stations in the important industrial area lying round the valleys of the Clyde, Forth and Tay, and including the principal shipbuilding, engineering, colliery and general manufacturing areas of Scotland, from Kilmarnock to Dundee. The population of the area is, roughly, three-quarters of that of the whole country. British Insulated Cables, Limited, were given the contract, as they were in the position to commence operations immediately, owing to the fact that they were already carrying out a scheme on somewhat similar lines in the Far East.

CERTAIN STATEMENTS HAVE appeared in the German Press recently with regard to the relations of Messrs. Siemens Brothers & Company, Limited, London, whose works are situated at Woolwich, and Messrs. Siemens & Halske, of Berlin. Messrs. Siemens Brothers, in a statement of the facts underlying these rumours, remark that it is becoming more and more obvious that rapid development in every field of industry necessitates not only an ever-increasing application of research and development, but collaboration with leading manufacturers engaged in the same business. This especially applies to the electrical industry. With this end in view, Siemens Brothers have entered into discussions with Siemens & Halske, Berlin, for the purpose of attaining the above objects and for providing for an interchange of patent rights, thereby avoiding the risk of patent litigation between firms of similar names and which formerly had been closely connected. In these pourparlers the question of a limited mutual financial interest has also been discussed, on the fundamental basis that the identity and control of each of the firms shall remain undisturbed. In fact, foreign control of Siemens Brothers is in any case precluded by virtue of their articles of association, and no changes in the articles of association, such as other companies are finding it advisable to make in this respect, are therefore necessary. No agreements have yet been concluded.

THE DIRECTORS of the Still Engine Company, Limited, have convened extraordinary meetings to approve a scheme for (1) reducing the share and loan capital from £316,000 to approximately £35,000; (2) converting the £18,941 prior lien debentures into income debentures; (3) converting the £73,363 8 per cent. debentures into £8,258 £1 preference shares; (4) cancelling 19s. 6d. per £1 share on the £220,550 shares issued; and (5) cancelling 6d. per share on the 75,000 "A" shares of 1s. each. The scheme provides for an increase of capital from its reduced figure of £86,839 to £303,750 by the creation of 10,000 10 per cent. non-cumulative participating preference shares of £1 each, 54,450 further ordinary shares of 6d. each, and 205,550 further shares of £1 each of no specified denomination. The share capital will, upon carrying the scheme into effect, be constituted as follows:—£10,000 in 10,000 10 per cent. non-cumulative participating preference shares of £1 each, of which £8,258 will be issued and fully paid up; £8,750 in 350,000 ordinary shares of 6d. each, of which £7,388 15s. 6d. will be issued and fully paid up; and £285,000 in 285,000 shares of £1 having no specified denomination, making a total authorised capital of £303,750 and an issued and fully paid capital of £15,646 15s. 6d. Arrangements have been concluded to dispose of the company's stationary-engine rights to a new company entitled Plenty-Still Oil Engines, Limited, which has already acquired another oil-engine business and works. As part consideration for the transfer of rights, the new company will allot 11,000 of its £1 shares to the Still Engine Company. In addition, the new company agrees to pay 50 per cent. of all receipts from any sub-licences it issues, and to contribute £2,000 per annum towards maintaining the Still Engine Company. A similar sum will also be contributed by the Still Locomotive Syndicate (which owns the rights of the locomotive branch).

Personal.

MR. S. PICKIS, of Messrs. Richter & Pickis, railway engineers, 6, Crescent, Minories, London, E.C.3, returned to London on September 7, after a twelve months' business tour in Venezuela, Colombia, etc.

MR. H. STEAD, the Honorary Secretary of the Lancashire Section of the Institute of British Foundrymen, has been appointed foreman over the wood and metal patternshops of Messrs. John Hetherington & Sons, Limited, Ancoats, Manchester. This firm has recently made some very important extensions to its foundries. These have been carried out under the supervision of Mr. E. Longden, the foundry manager. *Inter alia*, metallurgical laboratories are being installed.

DR. W. H. HATFIELD, of the Brown-Firth Research Laboratories, Sheffield, has accepted an invitation to give before the American Society of Steel Treating this year's memorial lecture to the late Professor Edward de Mille Campbell, at Philadelphia, on October 10. He has chosen as the title of his lecture, "The application of science to the steel industry," and intends to review generally recent developments of the metallurgy of iron and steel. Dr. Hatfield will also visit various American universities and steel centres, where he will raise and discuss various metallurgical matters.

Wills.

MOGER, C. H., of Birkenhead, consulting engineer	£6,758
DOUGLAS, J. T., of Liverpool, consulting engineer	£7,258
BRODIE, G. G. P., ironfounder, of Birmingham	£176,998
WARNER, M., of Messrs. French & Smith, metal brokers, Liverpool	£19,608
THORNYCROFT, SIR JOHN I., of Messrs. John I. Thornycroft & Company, Limited, shipbuilders and engineers	£151,029
HOWELL, S. E., of Messrs. Howell & Company, Limited, steel manufacturers, Sheffield, a former Master Cutler ...	£86,914
MIDDLETON, ELIAS, Wostenholm Road, Sheffield, general secretary of John Brown & Company, Limited, Sheffield	£16,718
HORSFIELD, A., of Horbury, Yorks, managing director of the Horbury Junction Iron Company, and of Messrs. Charles Roberts & Company, Limited	£33,670

Contracts Open.

Cairo, October 1.—Supply of: Bolts and nuts, pig-iron, iron split pins, galvanised-iron piping, brass, copper, cast-iron, lead and aluminium scrap, galvanised corrugated iron sheets, special tool and spring steel, wrought iron, nails, screws, etc., to the Model Workshops and Trade Schools, for the Egyptian Ministry of Education. The Department of Overseas Trade. (Reference C. 2871.)

Cairo, November 1.—Steel and iron lock and barrage gates, for the Egyptian Ministry of Public Works. The Department of Overseas Trade. (Reference A.X. 6819.)

Llanwern and Bishton, September 22.—3,700 yds. of 3-in. dia. cast-iron water mains, for the Magor Rural District Council. Messrs. Thomas & Morgan & Partners, engineers, Pontypridd. (Fee £5 5s., returnable.)

Thrapston, Northants., September 28.—6,700 yds. of cast-iron water main, etc., for the Rural District Council. Messrs. Pick, Everard, Keay & Gimson, 6, Millstone Lane, Leicester. (Fee £1 1s., returnable.)

Edinburgh, October 15.—(1) One 40-ton railway weighbridge; (2) one automatic rotary truck tippler; (3) three electric capstans; (4) belt conveyors and elevators; and (5) two ash telpher hoists, for the Corporation. Mr. Seddon, engineer and manager. (Fee £2 2s., returnable.)

London, S.E., September 28.—Steam travelling jib-type crane and 23 locomotive engines and tenders, 4-6-2 heavy type, 5 ft. 6 in. gauge, for the India Store Department, Belvedere Road, Lambeth, S.E.1. (Fee 5s., non-returnable, each schedule.)

Melbourne, November 12.—Steel chimneys and dust eliminators, for the State Electricity Commission. The Agent-General for Victoria, Victoria House, Strand, London, W.C.2. (Fee £1 1s., returnable.)

Reports and Dividends.

Sheffield Forge & Rolling Mills Company, Limited.—Loss for the year ended June, £9,392, bringing the total deficiency to carry forward up to £62,800.

Wright, Bindley & Gell, Limited.—Balance of revenue account (including £2,908 brought in), £17,283; dividend of 6 per cent. for the year on the ordinary shares, free of tax; to reserve fund, £1,000; carried forward, £3,243.

Greaves, Bull & Lakin (Harbury Works), Limited.—Gross profit for the 15 months ended June, after paying trading expenses, maintenance and repairs, £90,175; net profit, £75,532; debenture interest, £14,085; to reserve for depreciation, £20,000; dividend of 12½ per cent., less tax; carried forward, £7,072. The premium received on the issue of shares enabled the directors to write off the whole of the preliminary expenses, underwriting commission and discount on debentures, leaving £1,152 to be placed to reserve.

Obituary.

MR. J. E. RAINE, managing director of Messrs. Raine & Company, Limited, iron and steel manufacturers, of Delta Works, Derwenthaugh, died recently in Switzerland, aged 42. Mr. Raine was an international footballer, and at one time regularly played for Sheffield United and Newcastle United.

MR. HENRY SANSOM, formerly of Messrs. Sansom Bros., whose business is now carried on by the Stokes Castings, Limited, Union Foundry, Mansfield, has died at Mansfield, aged 66.

MR. JOSEPH PUGSLEY, founder and chairman of Messrs. Joseph Pugsley & Sons, Limited, engineers, machinery and metal merchants, Cattybrook Iron Works, Bristol, died recently.

New Companies.

Hot Pressed Products (1928), Limited, Speedex Works, Lancaster Street, Birmingham.—Capital £2,000 in £1 shares. Brassfounders, metal workers, etc.

Walden Engineering Company, Limited, 118, Percey Street, Belfast,—Capital £1,000 in £1 shares (500 preferred). Directors: Mrs. A. E. Hutton and Miss M. A. McLeavy.

Aluminium (II), Limited.—Capital £100 in £1 shares. Dealers in aluminium and similar metals, winners and workers of aluminium sodium or iron, etc. Directors: W. V. Esperson and Sir Christopher T. Needham.

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Eight new fully insulated High Temperature Kilns in course of erection at Worksop, Notts., for use in the execution of orders placed with the General Refractories, Co., Ltd., Sheffield.

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GENERAL REFRACTORIES Co., LTD.
SHEFFIELD

PROVIDE EMPLOYMENT FOR BRITONS AND A USE FOR BRITISH GOODS

The General Refractories Co., Ltd., spends time, money and thought on spreading the idea

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The idea has caught on to such an extent that men now apologise to their wives for using foreign cars and to themselves for using foreign goods.

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BRITISH STEELFOUNDERS & ENGINEERS

☛ *The Company feels justified in asking for all-round support when orders for Refractories are being placed, and suggests that such support should only be accorded, in any case, to British firms, and, amongst those, only to firms who do not import and sell Foreign Refractories in competition with British goods.*

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London Office: 92, CANNON STREET.
'Phone: City 8850 (Mr. A. C. TURNER).

Iron and Steel Markets.

Pig-Iron.

MIDDLESBROUGH.—Anticipations of an immediate expansion of demand in the Cleveland pig-iron market with the advent of autumn have not so far materialised, and although occasional activity may be noted, the actual volume of business passing is admittedly below the usual average for this period of the year. With production restricted to its present proportions, the output at Tees-side furnaces is about sufficient for home needs, export trade having shown slow improvement during the past few months, due, probably, to the comparatively high prices ruling for Cleveland quality. It would thus appear that any hopes of an improved demand for pig-iron must be centred chiefly, if not wholly, on the home market. It is, however, anticipated by home consumers that the forthcoming reduction of railway rates, which comes into force on December 1, may have the effect of lowering prices of pig-iron, and consequently many contracts are being held over on that account, buying for the moment being confined generally to small lots to cover immediate requirements. Meanwhile, current prices are very firm, as follow:—No. 1 Cleveland foundry iron, 68s. 6d.; No. 3 G.M.B., 66s.; No. 4 foundry, 65s.; No. 4 forge iron, 64s. 6d. per ton.

The recent announcement of a big order having been placed for steel rails will almost immediately necessitate an increase of hematite production, and must have a favourable effect upon this particular section of the industry. This view is reflected in a more animated market for East Coast hematite, from which the weak sellers are now being eliminated, and whilst there are still some prepared to accept 69s. per ton for mixed numbers, and 69s. 6d. per ton for No. 1 quality, the general quotations are 70s. and 70s. 6d. respectively. On the North-West Coast the market also is firmer, Bessemer mixed numbers being quoted at 68s. 6d. per ton at works.

LANCASHIRE.—Although still quiet as regards the amount of business recorded, the markets for foundry pig-iron in this area evince a more hopeful view of the outlook, and with stocks at local consumers' works practically exhausted, buying on a much freer scale is expected in the near future. Prices remain steady, with Derbyshire No. 3 at 67s. 6d., Staffordshire 67s., Cleveland 79s., and Scottish 81s. 6d. to 82s., all per ton delivered Manchester or equal.

THE MIDLANDS.—Throughout South Staffordshire and the adjacent districts there is a little more inquiry and a few more orders at the present moment for foundry pig, but, speaking generally, consumers are not buying any heavy qualities for forward delivery. Quotations are, however, steady, with Derbyshire No. 3 at 59s. to 60s., Northants, 59s. to 60s., both f.o.t. at furnaces, and Scottish at about 90s. per ton delivered locally.

SCOTLAND.—The more hopeful feeling recently reported has not abated, and prices of pig-iron are inclined to stiffen. So far, however, the hopeful feeling has not crystallised into any buying of important tonnages. Unfortunately, the founders are not themselves feeling any improvement in trade, and until this comes about it is not likely that they will come into the market for supplies beyond current requirements.

Finished Iron.

At Birmingham this week there was a somewhat better demand for Staffordshire marked bars, and the call should be increased in view of the orders which have come into this area recently for railway wagons. There is no change in price, £12 per ton being the Association figure at makers' works. There is no increased activity for crown and nut and bolt iron; all the works badly need orders, and they are quite unable to get sufficient work to keep their mills operating regularly. There is much competition between the works in this area and those farther afield, and prices are cut very much. Anything from £9 to £9 15s. is quoted for crown quality and from £8 12s. 6d. to £8 17s. 6d. for nut and bolt bars. Business for this class of iron is, however, still being placed with the Belgian mills, as their present price of £6 17s. 6d. to £7 per ton shows a big margin against the local producer.

Steel.

A slightly more optimistic note is expressed in reports from the chief centres of the steel industry, but at Sheffield this week actual business was on only a small scale. Basic steel billets sell more freely than acid qualities. Wire-rod business shows an improvement, the waning of Continental competition bringing more substantial orders to British makers, users realising that there is now no advantage in purchasing foreign material. All quotations are as before. At present the Continental works are apparently extremely well off for orders, and are in a position to regard the British market with indifference. In the tinplate market buyers are apparently becoming more confident and are placing their orders freely where the price is attractive. Quotations may be called :—Coke tins, 18s. to 18s. 3d. basis, net cash, f.o.b. Wales.

Scrap.

Business in all descriptions of iron and steel scrap is slowly recovering after an extended holiday interruption, but so far there has been little movement towards more active conditions. In the North-East area heavy cast iron is still an idle market, and quotations are unchanged at 60s. per ton for ordinary quality, and 65s. for machinery quality in handy pieces. In Scotland the scrap market is fairly normal. Prices are not fluctuating much, and suitable supplies are coming forward quite satisfactorily. Machinery cast-iron scrap is quoted at 66s., with heavy ordinary quality in pieces not exceeding 1 cwt. around 62s. 6d.; steelworks cast-iron scrap is quoted at 60s. to 61s. 3d. Old cast-iron railway chairs are also quiet at 64s. to 65s., and light cast-iron scrap is 57s. 6d. The above prices are all per ton, delivered f.o.t. consumers' works.

Metals.

Copper.—Fluctuations in warrant copper values have been confined within very narrow limits, and in the absence of active speculation quotations have become almost stabilised. The demand from actual consumers shows signs of broadening in this country, while in the United States a large business has been done both on domestic and export account. Consequently, it is believed that higher prices will rule in the near future, other factors contributing to enhanced values being an advance in share prices on Wall Street, and a quickening of European interest.

Closing quotations are :—

Cash.—Thursday, £62 16s. 3d. to £62 17s. 6d.; Friday, £63 1s. 3d. to £63 2s. 6d.; Monday, £63 10s. to £63 11s. 3d.; Tuesday, £63 11s. 3d. to £63 12s. 6d.; Wednesday, £63 18s. 3d. to £64.

Three Months.—Thursday, £63 7s. 6d. to £63 8s. 9d.; Friday, £63 11s. 3d. to £63 12s. 6d.; Monday, £64 1s. 3d. to £64 2s. 6d.; Tuesday, £64 2s. 6d. to £64 3s. 9d.; Wednesday, £64 8s. 9d. to £64 10s.

Tin.—Movements in the market for standard tin of late have been irregular in tendency, with business as a whole quiet and featureless. Consumptive demand is, however, fairly steady. The tinplate trade is taking delivery of good quantities, and is experiencing sufficient activity to suggest that there will be no falling off from this quarter for some time to come. As regards the future course of prices, it is probable that these will ease a little, or, at any rate, will not go much higher just yet, as production holds its recent high standard, while considerable tonnages are due to arrive.

Official closing prices :—

Cash.—Thursday, £211 17s. 6d. to £212; Friday, £211 17s. 6d. to £212 2s. 6d.; Monday, £213 7s. 6d. to £213 10s.; Tuesday, £215 to £215 5s.; Wednesday, £217 15s. to £218.

Three Months.—Thursday, £210 12s. 6d. to £210 15s.; Friday, £210 10s. to £210 15s.; Monday, £211 to £211 5s.; Tuesday, £212 7s. 6d. to £212 12s. 6d.; Wednesday, £213 10s. to £213 15s.

Spelter.—With consumption still much below seasonal average, the market for ordinary spelter continues quiet, pending a revival of demand in the galvanising trade, which is now on a moderate scale. Values of late have shown a somewhat weaker tendency, and are some shillings lower on the week. In fact, it is only sentiment and the unwillingness of producers to sell at cheaper rates that has sustained the tone in this market, as actual business is slow to improve.

Daily quotations are :—

Ordinary.—Thursday, £24 11s. 3d.; Friday, £24 8s. 9d.; Monday, £24 10s.; Tuesday, £24 10s.; Wednesday, £24 9s.

Lead.—The position in the market for soft foreign pig is thus stated by Messrs. Lewis, Lazurus & Sons, who report that demand from consumers is not of great volume, and with the possibility of more liberal supplies towards the end of the year the outlook is a little obscure. Something, no doubt, will depend upon the outcome of the producers' meeting last week, though this is not likely to prove to result in any immediate development of importance.

Closing prices :—

Soft Foreign Prompt.—Thursday, £22 3s. 9d.; Friday, £22 1s. 3d.; Monday, £21 18s. 9d.; Tuesday, £22 5s.; Wednesday, £22 3s. 9d.

World's Largest Silver Bell presented to H.M.S. "Nelson."

(*Continued from page* 202.)

is then revolved, thus removing any surplus of loam, leaving the mould or core to the size required.

The board for the outside diameter was made considerably larger than the finished size, but the board for the core was to size with the exception of the mouth of the bell (viz., where the clapper strikes), where an allowance was made for machining.

A full pattern was made for the crown portion of the bell, and therefore the mould for this was made in sand. These moulds were then put into drying ovens, and all moisture thoroughly extracted. This must be done gradually, and therefore these moulds were in the ovens for two or three days. The complete mould consisted of three parts, and after drying these are assembled by means of locating box pins (which ensure a perfect joint), and the mould is now ready to receive the metal.

The silver was melted in new graphite pots and the fuel used for melting specially selected sulphur-free coke. The melting of the silver was pyrometrically controlled by the laboratory. The molten silver is collected in the runner box, a ball valve preventing the silver from entering the mould until nearly all the silver is transferred from the pots, when the valve is removed, and the silver enters the mould with considerable force, thereby ensuring the metal will enter all parts of the mould before freezing takes place. This is particularly necessary with silver, as this metal soon freezes or sets.

In addition to the runner box two large square risers about 8 in. by 6 in. section were placed at the top of the mould, and into these the surplus metal runs and also any dirt that might be in the mould or metal. The bell was cast crown uppermost.

The mould was removed within a few hours of casting; the casting was found to be perfect. The runners and risers were then removed in the trimming shop, and the bell then transferred to the machine shop for turning to size and weight.

The clapper was also made of solid silver, and of two pieces, the striking portion being cast and machined, and the rod being forged with a hook at one end, and screwed at the other for connecting to the striking portion. The eye on which the clapper hung was cast and machined and screwed into the crown of the bell.

The actual weight of silver received was 7,393 ozs. troy, and the weight returned in one form or the other was 7,332 ozs. troy. There were only 61 ozs. troy lost in melting, etc., a percentage of less than 1 per cent. Special precautions were very necessary to guard against undue loss, involving considerable expense.

The casting was trimmed on specially-cleaned floor covered with paper, and all filings and chippings swept up. The lathe on which the bell was turned was enclosed with boarding lined with paper, and all turnings were swept up every day and transferred to a safe. The filing and burnishing was done in an open-top box lined with paper.

BAILEY'S
TRANSVERSE
: TESTER :
FOR THE FOUNDRY.

Tests Bars of Cast Iron, Bronze, Etc.
Testers for all Materials, Oils, etc.
Air Compressors, Pumps, Reducing Valves.
SIR W. H. BAILEY & CO., Ltd., Manchester.

Sterling

SOLID RIBBED ROLLED STEEL

MOULDING BOXES

are recognised as Standard Box equipment by the majority of the leading foundries and engineering establishments in this country and overseas.

Because they speed up production, save unnecessary labour, produce accurate castings and make for all-round efficiency.

If you are not a user of Sterling Boxes your competitors have the advantage of you.

STERLING . FOUNDRY SPECIALTIES LTD.

London Office:
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Telephone : 3345 BEDFORD.
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Code : WESTERN UNION.

WEEKLY PRICE CURRENT.

COPPER.

	£ s. d.
Standard cash	63 18 3
Three months	64 8 9
Electrolytic	70 5 0
Tough	66 10 0
Best selected	66 10 0
Sheets	94 0 0
India	77 15 0
Wire bars	70 10 0
Do. September	70 10 0
Do. October	70 10 0
Ingot bars	70 10 0
H.C. Wire rods	74 10 0
Off. av. cash, August	62 10 2 17/21
Do. 3 mths., August	62 18 11 17/21
Do., Sttlmnt., August	62 10 4 5/7
Do., Electro, August	69 0 0
Do., B.S., August	65 14 2
Aver. spot price, copper, Aug.	62 10 2½
Do., Wire bars, August	69 5 0
Solid drawn tubes	13½d.
Brazed tubes	13½d.
Wire	10d.

BRASS.

Solid drawn tubes	11½d.
Brazed tubes	13½d.
Rods, drawn	10½d.
Rods, extd. or rlld.	7½d.
Sheets to 10 w.g.	10½d.
Wire	9½d.
Rolled metal	9½d.
Yellow metal rods	7½d.
Do. 4 × 4 Squares	8d.
Do. 4 × 3 Sheets	8½d.

TIN.

	£ s. d.
Standard cash	217 15 0
Three months	213 10 0
English	217 15 0
Bars	217 0 0
Straits	218 10 0
Australian	216 5 0
Eastern	215 15 0
Banca	223 0 0
Off. av. cash, August	212 19 10 1/7
Do., 3 mths., August	210 0 2 3/7
Do., Sttlmt., August	212 19 1 1/7
Aver. spot, August	212 19 10½

SPELTER.

	£ s. d.
Ordinary	24 9 0
Remelted	23 0 0
Hard	19 10 0
Electro 99.9	28 0 0
English	25 0 0
India	21 5 0
Zinc dust (Nom.)	35 5 0
Zinc ashes	7 15 0
Off. aver., August	24 12 6 15/21
Aver., spot, August	24 10 9½

LEAD.

	£ s. d.
Soft foreign ppt.	22 3 9
English	23 10 0
Off. average, August	21 12 7 1/3
Average spot, August	21 12 8

ZINC SHEETS, &c.

	£ s. d.
Zinc sheets, English	33 0 0
Do. V.M. ex whf.	31 5 0
Rods	39 0 0
Boiler plates	29 0 0
Battery plates	30 10 0

ANTIMONY.

	£ s. d.
Special brands, Eng.	59 0 0
Chinese	39 0 0
Crude	33 10 0

QUICKSILVER.

	£ s. d.
Quicksilver	23 15 0

FERRO-ALLOYS AND STEEL-MAKING METALS.

Ferro-silicon—	
25%	7 17 6
45/50%	12 0 0
75%	19 0 0
Ferro-vanadium—	
35/50%	14/- lb. Va.
Ferro-molybdenum—	
70/75% c. free	4/3 lb. Mo.
Ferro-titanium—	
23/25% carbonless	1/2 lb.
Ferro-phosphorus, 20/25%	£18 0 0
Ferro-tungsten—	
80/85%, c. fr.	1/3 lb.
Tungsten metal powder—	
98/99%	1/7 to 1/7½ lb.
Ferro-chrome—	
2/4% car.	£30 0 0
4/6% car.	£21 7 6
6/8% car.	£20 12 6
8/10% car.	£20 0 0
Ferro-chrome—	
Max. 2% car.	£32 15 0
Max. 1% car.	£37 0 0
Max. 0.70% car.	£42 0 0
70%, carbonless	1/- lb.
Nickel—99%, cubes or pellets	£175 0 0
Ferro-cobalt	9/- lb.
Aluminium 98/99%	£98 0 0
Metallic chromium—	
96/98%	2/7 lb.
Ferro-manganese (net)—	
76/80%, loose	£13 15 0
76/80%, packed	£14 15 0
76/80%, export	£13 10 0
Metallic manganese—	
94/96%, carbonless	1/6 lb.

Per ton unless otherwise stated.

HIGH-SPEED TOOL STEEL.

Finished bars, 14% tungsten	£0 2 3
Finished bars, 18% tungsten	£0 2 9

Per lb. net, d/d buyers' works.

Extras—

Rounds and squares, 3 in. and over	4d. lb.
Rounds and squares, under ½ in. to ¼ in.	3d. lb.
Do., under ¼ in. to ⅛ in.	1/- lb.
Flats, ½ in. × ¼ in. to under 1 in. × ⅛ in.	3d. lb.
Do., under ½ in. × ¼ in.	1/-lb.
Bevels of approved sizes and sections	6d. lb.

Bars cut to length, 10% extra.

Scrap from high-speed tool steel—

Scrap pieces	3d.
Turnings and swarf	1d.

Per lb. net, d/d steel makers' works.

SCRAP.

	£ s. d.	£ s. d.
South Wales—		
Hvy. steel	3 7 0	to 3 8 6
Bundled steel and shrngs.	3 2 6	to 3 7 6
Mixed iron and steel	3 0 0	to 3 2 0
Heavy cast iron	2 16 0	to 2 18 6
Good machinery for foundries	3 2 6	
Cleveland—		
Heavy steel	2 15 0	
Steel turnings	2 8 0	
Cast iron borings	2 1 6	
Heavy forge	3 10 0	
Bushelled scrap	3 0 0	
Cast-iron scrap	3 2 6	
Lancashire—		
Cast-iron scrap	3 0 0	
Hvy. wrought	2 17 6	
Steel turnings	2 2 6	

London—Merchants' buying prices delivered yard.

Copper (clean)	52 0 0
Brass	37 0 0
Lead (less usual draft)	18 0 0
Tea lead	16 0 0
Zinc	15 0 0
New aluminium cuttings	66 0 0
Braziery copper	47 0 0
Gunmetal	47 0 0
Hollow pewter	150 0 0
Shaped black pewter	105 0 0

PIG-IRON.

(f.o.t. unless otherwise stated.)

N.E. Coast—	
Foundry No. 1	68/6
Foundry No. 3	66/-
Foundry No. 4	65/-
Forge No. 4	64/6
Hematite No. 1	70/6
Hematite M/Nos.	70/-
N.W. Coast—	
Hem. M/Nos. d/d Glas.	78/6
,, d/d Birm.	86/-
Midlands—	
Staffs. common*	67/6
,, No. 4 forge	56/-
,, No. 3 fdry.	60/-
Shrops. basic	—
,, Cold blast, ord.*	—
,, ,, roll iron*	—
* d/d Birmingham.	
Northants forge	51/6
,, fdry. No. 3	55/6
Derbyshire forge	59/-
,, fdry. No. 3	59/6
,, basic	60/-
Scotland—	
Foundry No. 1	75/-
,, No. 3	70/-
Hem. M/Nos.	74/-
Sheffield (d/d district)—	
Derby forge	61/6
,, fdry. No. 3	64/-
Lincs. forge	62/6
,, fdry. No. 3	64/-
E.C. hematite	78/6
W.C. hematite	84/-
Lincs. (at furnaces)—	
Forge No. 4	58/-
Foundry No. 3	59/6
Basic	59/-
Lancashire (d/d eq. Man.)—	
Derby forge	—
,, fdry. No. 3	67/6
Northants foundry No. 3	—
Dalzell, No. 3(special)	100/- to 102/6
Summerlee, No. 3	87/- to 90/-
Glengarnock, No. 3	87/- to 90/-
Gartsherrie, No. 3	87/- to 90/-
Monkland, No. 3	87/- to 90/-
Shotts, No. 3	87/- to 90/-

FINISHED IRON AND STEEL.

Usual District deliveries for iron; delivered consumers' station for steel.

Iron—	£ s. d.	£ s. d.
Bars (cr.) nom.	9 10 0	to 10 15 0
Nut and bolt iron	8 12 6	to 8 17 6
Hoops	11 10 0	
Marked bars (Staffs.) f.o.t.	12 0 0	
Gas strip	11 10 0	
Bolts and nuts, ¾ in. × 4 in.	15 5 0	
Steel—		
Ship plates	8 7 6	to 8 12 6
Boiler plts.	10 10 0	
Chequer plts.	10 12 6	
Angles	7 17 6	
Tees	8 17 6	
Joists	7 17 6	
Rounds and squares, 3 in. to 5½ in.	8 17 6	
Rounds under 3 in. to ½ in. (Untested)	7 15 0	and upwards
Flats, over 5 in. wide and up	8 7 6	
Flats, 5 in. to 1½ in.	7 17 6	
Rails, heavy	8 10 0	
Fishplates	12 10 0	
Hoops (Staffs.)	10 0 0	
Black sheets, 24g.	10 0 0	
Galv. cor. shts., 24g.	13 10 0	
Galv. fencing wire 8g. plain	12 10 0	
Billets, soft	6 2 6	to 6 10 0
Billets, hard	7 2 6	to 7 12 6
Sheet bars	6 0 0	
Tin bars	6 0 0	

PHOSPHOR BRONZE.

	Per lb. basis.
Strip	1 2½
Sheet to 10 w.g.	1 3
Wire	1 3½
Rods	1 3
Tubes	1 7½
Castings	1 2

Delivery 3 cwt. free.
10% phos. cop. £40 above B.S.
15% phos. cop. £50 above B.S.
Phosphor tin (5%) £30 above price of English ingots.
C. Clifford & Son, Limited.

NICKEL SILVER, &c.

	per lb.
Ingots for raising	9d. to 1/3
Rolled—	
To 9 in. wide	1/3 to 1/9
To 12 in. wide	1/3½ to 1/9½
To 15 in. wide	1/3½ to 1/9½
To 18 in. wide	1/4 to 1/10
To 21 in. wide	1/4½ to 1/10½
To 25 in. wide	1/5 to 1/11
Ingots for spoons and forks	9d. to 1/5½
Ingots rolled to spoon size	1/- to 1/8½
Wire round—	
3/0 to 10 G.	1/6½ to 2/1½

with extras according to gauge.

AMERICAN IRON AND STEEL.

At Pittsburgh unless otherwise stated.

	Dols.
No. 2X foundry, Phila.	20.26
No. 2 foundry, Valley	16.50
No. 2 foundry, Birm.	16.25
Basic	17.76
Bessemer	18.76
Malleable	18.76
Grey forge	18.01
Ferro-mang. 80% d/d	105.00
O.-h. rails, h'y at mill	43.00
Bess billets	32.00
O.-h. billets	32.00
O.-h. sheet bars	32.00
Wire rods	42.00
	Cents.
Iron bars, Phila.	2.12
Steel bars	1.90
Tank plates	1.90
Beams, etc.	1.96
Skelp, grooved steel	1.90
Skelp, sheared steel	1.90
Steel hoops	2.20
Sheets, black, No. 24	2.65
Sheets, galv., No. 24	3.40
Sheets, blue an'l'd., 9 and 10	2.00
Wire nails	2.55
Plain wire	2.40
Barbed wire, galv.	3.20
Tinplates, 100 lb. box	$5.25

COKE (at ovens).

Welsh foundry	27/- to 36/-
,, furnace	19/- to 21/-
Durham and North.	
,, foundry	15/- to 15/6
,, furnace	14/-
Midlands, foundry	—
,, ,, furnace	12/-

TINPLATES.

f.o.b. Bristol Channel ports.

I.C. Cokes	20×14 box	18/- to 18/3
,,	28×20 ,,	36/3
,,	20×10 ,,	27/-
,,	18⅞×14 ,,	18/9
C.W.	20×14 ,,	15/6
,,	28×20 ,,	33/6
,,	20×10 ,,	22/-
,,	18⅞×14 ,,	15/9
Terneplates	28×20	33/6 per box basis f.o.b.

SWEDISH IRON.

Bars, hammered,	£17 10 0 to £18 10 0
Rolled Ord.	£15 0 0 to £15 10 0
Nail rods	£15 7 6 to £15 15 0
Keg. steel nom.	£32 to £33
Faggot steel nom.	£22 to £23
Blooms, according to quality	£8 to £12
Pig-iron	£5 15 0 to £6 0 0

all f.o.b. Gothenburg

TUBES AND FITTINGS.
Up to and incl. 6 in.

	Tubes.	Fittings.
Gas	67½%	50%
Water	63½%	45%
Steam	60%	40%

W.I. 10% extra.

DAILY FLUCTUATIONS.

Standard Copper (cash).

	£	s.	d.	
Sept. 13	62	16	3	No change
,, 14	63	1	3	inc. 5/-
,, 17	63	10	0	,, 8/9
,, 18	63	11	3	,, 1/3
,, 19	63	18	3	,, 7/-

Electrolytic Copper.

	£	s.	d.	
Sept. 13	69	5	0	inc. 5/-
,, 14	69	5	0	No change
,, 17	70	10	0	inc. 15/-
,, 18	70	5	0	dec. 5/-
,, 19	70	5	0	No change

Standard Tin (cash).

	£	s.	d.	
Sept. 13	211	17	6	inc. 25/-
,, 14	211	17	6	No change
,, 17	213	7	6	inc. 30/-
,, 18	215	0	0	,, 32/6
,, 19	217	15	0	,, 55/-

Tin (English ingots).

	£	s.	d.	
Sept. 13	211	10	0	inc. 35/-
,, 14	212	5	0	,, 15/-
,, 17	213	0	0	,, 15/-
,, 18	215	0	0	,, 40/-
,, 19	217	15	0	,, 55/-

Zinc Sheets (English).

	£	s.	d.	
Sept. 13	33	0	0	No change
,, 14	33	0	0	,, ,,
,, 17	33	0	0	,, ,,
,, 18	33	0	0	,, ,,
,, 19	33	0	0	,, ,,

Spelter (ordinary).

	£	s.	d.	
Sept. 13	24	11	3	dec. 2/6
,, 14	24	8	9	,, 2/6
,, 17	24	10	0	inc. 1/3
,, 18	24	10	0	No change
,, 19	24	9	0	dec. 1/-

Lead (English).

	£	s.	d.	
Sept. 13	23	10	0	No change
,, 14	23	10	0	,, ,,
,, 17	23	5	0	dec. 5/-
,, 18	23	5	0	No change
,, 19	23	10	0	inc. 5/-

Exports of Iron Castings in August and the eight months 1928, compared with August and the eight months 1927.

	August, 1927.	August, 1928.	Eight months, 1927.	Eight months, 1928.	August, 1927.	August, 1928.	Eight months, 1927.	Eight months, 1928.
BUILDERS' CASTINGS—								
Stoves, Grates, etc., Cisterns, Baths, etc., and cooking and washing boilers:—	Tons.	Tons.	Tons.	Tons.	£	£	£	£
To Argentine Republic	90	175	1,059	1,223	3,556	6,485	39,409	51,370
,, British South Africa	150	302	1,816	2,439	5,708	10,603	65,597	85,067
,, ,, East Indies	119	125	753	1,028	5,555	5,205	32,888	44,854
,, Australia	61	52	653	459	3,793	3,032	37,232	31,851
,, New Zealand	89	125	1,378	1,285	4,211	6,606	69,966	64,927
,, Other countries	509	869	5,204	6,347	25,465	39,907	264,147	293,819
Total	1,018	1,648	10,863	12,782	48,288	71,838	509,239	571,888
PIPES AND FITTINGS—CAST—								
To Argentine Republic	450	852	6,529	6,334	6,160	8,121	71,906	64,315
,, British South Africa	2,854	213	7,568	3,140	26,241	2,952	91,110	49,833
,, ,, India	554	573	4,714	6,030	9,248	10,631	74,372	79,062
,, Straits Settlements and Malay States	1,933	1,241	9,975	10,635	19,073	13,396	98,560	97,361
,, Ceylon	238	830	1,029	1,597	2,615	6,826	12,162	16,199
,, Australia	543	382	6,144	6,461	7,703	5,875	72,565	72,160
,, Other Countries	5,924	5,005	40,410	38,984	72,400	65,748	531,550	512,457
Total	12,496	9,096	76,369	73,181	143,440	113,549	952,225	892,287
HOLLOW-WARE—								
Cast, not Enamelled, and Cast, Tinned	294	380	3,034	3,088	11,775	12,234	119,107	113,847
,, Enamelled	58	61	465	521	5,962	6,525	47,014	49,219
CASTINGS, in the rough—								
Iron	137	76	788	1,032	56,760	57,635	429,655	406,265
Steel	70	30	592	412	4,492	3,386	28,709	32,825

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SMALL ADVERTISEMENTS.

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(A remittance should accompany instructions.)

SITUATIONS VACANT AND WANTED.

PRACTICAL FOUNDRYMAN, age 34 (leading hand with engineering firm), desires position as Foreman or Assistant; well trained in all branches of the trade.—Box 820, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

YOUNG MOULDER desires position as Foreman or Assistant-Foreman; sound experience in iron and brass foundry practice; good technical training.—Box 816, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

YOUNG MAN, seven years' experience in ferrous and non-ferrous foundry practice, sound technical education, wishes progressive position on staff of modern foundry.—Box 818, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

EXPERIENCED Engineer and Foundry Manager desires position; practical and theoretical training; expert in use of moulding machines and design of pattern plates; also cupola control and metal mixing, heavy or light work; highest references for integrity and ability.—Box 814, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

QUICK Preparation of Moulding Sand by sand slinging machines. Old-established German foundry machine makers want definitely well-connected Agent for the British Empire.—Reply, Box 812, Offices of THE FOUNDRY TRADE JOURNAL, 49 Wellington Street, Strand, London, W.C.2.

QUALCAST, LIMITED, Specialists in Machine Moulded Light, Grey Iron Castings, are erecting a new and thoroughly up-to-date Foundry, and require an Assistant Foundry Foreman.—Apply by letter, stating age, experience and salary required to WORKS MANAGER, Qualcast, Limited, Derby.

AGENT wanted for Birmingham district; must have good connection with steel, iron and brass foundry for the sale of refractory mortar.—Apply by letter, Box 824, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

PROPERTY.

FOR SALE, small Malleable Ironfoundry, as a going concern; established trade in specialities; scope for developing general small castings; private sidings; situate industrial area.—Box 822, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

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SAND MIXERS.—New and second-hand. Ask us to quote.—W. BREALEY & COMPANY, LIMITED, Prospect Works, Hawksley Avenue, Sheffield.

SAND MIXERS AND CORE-MAKING MACHINES.—Ask for our quotation for new Machines; prices from £14 upwards. Write for List.

SULRON, LIMITED,
FOUNDRY ENGINEERS,
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Vertical Rotary Surface and Ring Grinding Machine, with 12-in. dia. magnetic chuck, wheel 8½-in. dia.

"DIAMOND" Surface Grinding Machine, with magnetic chuck 2 ft. 8 in. x 10 in.

No. 11 BROWN & SHARPE Plain Grinding Machine, 6 in. x 32 in.

No. 2 TAFT PIERCE Universal Cylindrical Grinding Machine, 10 in. x 30 in.

Three LANCASHIRE BOILERS, 30 ft. x 8 ft., reinsure 150 lbs. pressure.

Two dish-ended LANCASHIRE BOILERS, by Thompson, 30 ft. x 8 ft., reinsure for 140 lbs. per sq. in. working pressure.

15-ton LOCO. STEAM SHUNTING CRANE (Cowans Sheldon), 27-ft. jib, 80 lbs. W.P.

12-ton LOCO. STEAM CRANE (Ransome & Rapier), 45-ft. jib, 80 lbs. W.P.

CATALOGUE (10,000 Lots) ON APPLICATION.

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MACHINERY.—*Continued.*

SANDBLAST COMPRESSORS.—Two new vertical water jacketed Compressors, totally enclosed type, duty 585 cub. ft. to 40 lbs. working pressure; specially suited to sandblast work; £90 each.—ALEXANDER HAMMOND, Foundry Machinery Merchant, Boxted, Slough.

PATENTS AND TRADE MARKS.

INFORMATION HANDBOOKS, Advice, and Cons. free; King's Patent Agency, Ltd.—B. T. KING, C.I.M.E. (Regd. Pat. Agent, G.B., U.S.A., and Can.), 146A, Queen Victoria Street, E.C.4. 40 years' refs. 'Phone: 0682 Central.

THE owner of British Patent No. 236,404, for improvements in stoking boiler and other furnaces, is desirous of entering into negotiations with one or more firms in Great Britain for the purpose of exploiting the above invention, either by sale of the patent rights or by the grant of a licence or licences to manufacture on royalty.—Inquiries should be addressed to MESSRS. ABEL & IMRAY, 30, Southampton Buildings, London, W.C.2.

MISCELLANEOUS.

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FOR SALE, about 4 tons cast foundry moulds, cheap.—B. HORTON & SON, LIMITED, Westerham Station, Kent.

'Phone: 287 SLOUGH.

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150 lb. MORGAN Cokefired "S" type ..	£40
250 lb. MORGAN Cokefired "S" type ..	£48
400 lb. MORGAN Oilfired, NEW	£80
600 lb. MORGAN Cokefired "A" type ..	£85
800 lb. MORGAN Cokefired "A" type ..	£90

ALL RELINED READY FOR USE

EVERY SIZE LADLE (1 cwt. to 15 ton) in Stock

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